Preliminary Science Use Scenarios for proposed NEPTUNE Canada Observing Systems

compiled by John Garrett

Preliminary Science Use Scenarios

Science Use Scenarios are a mechanism to stimulate and focus communication between scientists planning to use the NEPTUNE Cabled Observatory and the NEPTUNE Canada team responsible for planning, designing, acquiring and installing the infrastructure.

They deal with both individual observing systems, which may consist of one instrument at one site or many instruments distributed at several sites, and the ensemble of all observing systems expected to be used through the system.

For individual observing systems the focus is on how the observing system and its users will connect and interact with the infrastructure:

- what the users and their equipment require to conduct their research;
- what the infrastructure requires to achieve its goals;
- what the users will provide;
- what the infrastructure will provide.

For the ensemble the focus is on potential interactions between observing systems, both positive (context, supporting data) and negative (interference, contamination).

The science user scenarios will evolve iteratively as design and planning advance.

Questionnaires were distributed to the participants in the NEPTUNE Canada Observing System workshop held in Victoria, September 25-27, 2004. This is a compilation of the responses received electronically through November 6, 2004.

1. Information Base

The science user groups made extraordinary efforts to help, but the information is still limited. Only a few potential science user groups are represented. The groups are still in the early stages of planning and thinking so that the detail they have provided is very preliminary and likely to change.

The following groups provided completed questionnaires.

Pre-workshop proposal	Group at Workshop	Informative workshop document	Questionnaire
Regional Seismology	Plate Tectonics	Yes	1.Regional Seismic Network 2 Geodetic Monitoring of Plate Motion 3. Tsunamis
Hydrate Experiments	Fluids: Hydrates	Yes	Hydrates
Dynamic Processes of Fluids in Ridge Environments	Fluids: Ridge	No	1. Water Column Properties at Endeavour Ridge 2. Isosampler
Canyon Processes and Dynamics – Barkley Canyon	Ocean Climate and Marine Biota	Yes	Ocean Climate and Water Column Processes
Deep Sea Ecosystems: Vent Ecology	Deep Sea Ecosystems	Yes	1. Profiling winch 2. CTD 3. Current meters 4.Video Plankton Imager 5. CanRail traversing carriage 6.: SedView sediment imaging system 7. Bottom mounted "Bare Bones" system 8. Larval Pump 9. Benthic Still Camera
-Hybrid Underwater Vehicle -Integrated Acoustics System -High Definition Video	Engineering and Computational Research	Yes: testbed on VENUS	

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The Engineering and Computational Research Group decided that their initial instrument proposal would be for a test bed using the VENUS facility in Saanich Inlet. This involves no initial 'science use' of NEPTUNE, and no scenario has been prepared. This was discussed briefly with the group leader and they may eventually submit a use case document looking ahead to eventual use of NEPTUNE. A medical emergency delayed the response from the part of the Ridge Crest Fluids proposal group.

The information has been organized according to a hierarchy of categories:

- *Theme*: one of the five NEPTUNE Canada themes,
  - *Proposal:* a research objective or question that would be used to obtain funding for observing systems or other use of NEPTUNECanada, and
    - *Observing System*: a logical ensemble of instruments or other equipment
      - *Component or Instrument*: an individual piece of equipment that would be included in an Observing System.

Thus, within the Ocean Climate and Impacts theme, we expect to see a proposal for research on variations productivity in the upper layer that will require a set of instruments mounted on a vertical profiler. The Observing System is the entire vertical profiling package. The components or instruments will include sensors for conductivity, temperature, depth, transmissivity, as well as the vertical profiling winch.

Appendix A is the questionnaire.

Appendix B is a compilation of all the responses received by November 3, augmented in some cases by information from the Workshop Presentations or obtained through correspondence with members of the groups. In some cases one questionnaire response addresses an entire Observing System including many components while in others the questionnaire response describes only one or two components in an observing system..

The responses to the individual questions in the questionnaire are also assembled in a primitive database using Microsoft Excel, usecasesummary.xls. The responses are included in worksheets called

- Proposal, which includes contacts, and a summary of the proposal. This worksheet includes some proposals for which information is expected but not yet received.
- Observing System, which includes the objectives of the observing system and the questions to be answered. This worksheet is complete for the information received to November 1.
- Instrument, which includes all available detail on each piece of equipment. This worksheet is complete for the information received to October 8.
- Site Aggregate, which lists all the sites for each observing system, the feature that defines the site, the nearest NEPTUNE node, and fields to summarize the total or representative requirements of this observing system at this specific site. This worksheet is not yet complete: it includes all sites, and the fields at the far right identify the instruments at each site, but the representative details have to be linked by hand and this is not yet finished. This is part of Task 4 in this project.
- Index, which indicates which worksheets address each of the questions in the questionnaire

The usecasesummary.xls database also includes a worksheet for each proposed NEPTUNE node, summarizing the observing systems located near that node. Fields are provided to sum up power and bandwidth needs, but the information available so far is not sufficiently quantitative.

2. Observations

The science groups have generally displayed readiness to adapt to the constraints of the NEPTUNE Canada infrastructure where possible without compromising the scientific objectives and where information is available on the infrastructure. Channels for frequent and ongoing communications with all identifiable potential users would help everyone make informed decisions.

Detailed surveys around potential node sites, including bottom characteristics, will be needed to determine exactly where observing systems should go. Until these are available it will be hard to be specific about the distance between any observing system and the nearest node

There will be a demand for cables to connect observing systems to the nodes over a wide range of distances. In most cases the science user groups have not been very specific about the site requirements, but where they have it is clear that the sites connected to a particular node may be several kilometre apart. It is also clear that there is great potential for interference between observing systems during installation and operation, so that individual systems may need to be a kilometre or more away from the other systems at a node.

Most of the proposed observing systems include many sensors and instruments that are currently available and for which reliability can be established. These devices have a wide range of input voltages and communication protocols. The necessary interfaces should be identified as early as possible.

Several new electro-mechanical systems are required, e.g. profiling winches, bottom traversing carriage, electro-optical mooring, rover. These will require a significant development effort. However a few basic systems should meet a broad range of identified or foreseeable needs for several groups.

Several groups have very similar needs for profiles over between 100m and 500m of the water column for water properties, transmissivity and fluorometry. It may be possible to develop a common system, perhaps with different sensor ranges or sensitivities.

Images and video, including video plankton imagers, represent the highest bandwidth requirements. Motors for pumps and winches represent the highest power requirements, and the performance of these systems will be limited by the power available. Lights for video are also a significant power requirement.

The development of science use cases focusing on the practical details of conducting experiments with NEPTUNE provides a useful complement to the development of the scientific justification for those experiments. It should be an ongoing, iterative process. The present template could be improved in a number of ways. Its most significant shortcoming is the absence of a place for a single concise description of the planned observing system.

Appendix A:

NEPTUNE Canada Science Use Scenarios

Science Use Scenarios are a mechanism to stimulate and focus communication between scientists planning to use the NEPTUNE Cabled Observatory and the NEPTUNE Canada team responsible for planning, designing, acquiring and installing the infrastructure.

They deal with both individual observing systems, which may consist of one instrument at one site or many instruments distributed at several sites, and the ensemble of all observing systems expected to be used through the system.

For individual observing systems the focus is on how the observing system and its users will connect and interact with the infrastructure:

- what the users and their equipment require to conduct their research;
- what the infrastructure requires to achieve its goals;
- what the users will provide;
- what the infrastructure will provide.

For the ensemble the focus is on potential interactions between observing systems, both positive (context, supporting data) and negative (interference, contamination).

The science user scenarios will evolve iteratively as design and planning advance.

This document describes one observing system. There should be a science use scenario for each observing system.

The NEPTUNE Canada User Guide provides the other part of the picture. It contains information for the prospective user. A very preliminary draft is attached as an appendix to elicit suggestions and comments as to what the final version should contain.

Contents:

Section 1. Overview of Purpose and Interests

Name or title of the observing system:

Person to contact for information:

Purpose of the observing system:

What questions are the observations intended to answer?

Who is responsible for specification of the observing system?

Who are expected to be the initial users of data from this observing system?

Is there a specific feature or site where the observing system must be located?

What is(are) the nearest NEPTUNE Canada node(s)?

How far is this from the observing system site?

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?

How often will measurements be taken?

Will this change according to conditions, and how?

What are the consequences of interruptions of a few hours, a day, several days, a month*?

How often will the raw measurements be transmitted to shore, and in what format?

How many bytes of data may be expected in each transmission?

What is required to transform the raw measurements into meaningful units?

What format is planned for the data in meaningful units?

Is there a commonly accepted standard and what is it?

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?

How will these corrections be determined*?

How often will they need to be changed*?

Who will be responsible for calibration corrections*?

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)

Who will be responsible for monitoring the quality of the real-time data?

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?

What real time NEPTUNE data not provided by this observing system will be needed for the research?

If the complete calibrated data is not available in real time, when will it be available to other users?

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?

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Is there an existing disciplinary repository for archived data?

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?

What events might require action?

What information will be needed to make decisions to initiate an action?

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?

What is the expected format of commands (e.g. serial sequences, web-based frames)?

What will be the amount and rate of information exchange during a controlled action?

Section 4: Communications

How often will the observing system communicate with shore?

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)

What will be the message format?

What will be the impact of a planned interruption in communication, e.g. planned network service?

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?

What is planned to minimize this impact?

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?

How frequently will the instrument need to receive a time signal?

What is the best format for the time signal?

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)

What are the consequences of an interruption in the time signal?

Section 6: Power

What voltage is the observing system expecting from the network?

What is the minimum current required?

What fraction of the time will the observing system be drawing the minimum?

What is the maximum current required (e.g. for motors, lights)?

How often will this be needed and for how long each time?

Is there any intermediate level of current requirement?

If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?

What is planned to minimize this impact?

Section 7: Emissions and sensitivity

Will the observing system emit **sound**?

What will be the source and nature of the **sound**?

What frequencies and power levels?

How often?

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?

What power levels, frequencies or other characteristics would result in interference?

Will the observing system emit **light**?

What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**?

What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?

What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments?

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**

What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?

How, where and when will the observing system be tested to establish its reliability*?

Has a reliability analysis been conducted?

What is the probable failure rate?

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?

Does the sea floor need to have particular characteristics?

What?

What other characterstics should the site have?

Will it be self-contained or is it expected to mount on or in another structure?

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector?

How big is it likely to be (height, width, depth, weight)?

How accurately will it have to be positioned (horizontal, vertical, orientation)?

Does it require protection from biofouling?

What is planned?

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?

How far is it likely to be from a Science Node?

What are the impacts of a planned interruption to the connection to the network*?

What are the impacts of an unplanned interruption to the network connection*?

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector?

How accurately will it have to be positioned (horizontal, vertical, orientation)?

What are expected (planned) servicing requirements?

What will need to be done?

How often?

How long will it take?

Who will be responsible for the costs?

How far in advance must the servicing schedule be known to have minimum impact on use of the data?

Will emergency servicing be expected if the observing system fails?

Who will be responsible for the decision?

Who will be responsible for the cost?

Section 12: Documentation

What documentation is available?

on the science plan

on the sensors and measurment techniques

on the design and specification of the observing system

What information and documentation will be needed?

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Questionnaires were distributed to the participants in the NEPTUNE Canada Observing System workshop held in Victoria, September 25-27, 2004. This is a compilation of the responses received electronically.

Table of Contents

Theme 1 Plate Tectonic Processes and Earthquake Dynamics

Observing System 1 :NEPTUNE Seismic Network

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
NEPTUNE Seismic network

Person to contact for information:
Garry Rogers

Purpose of the observing system:
to record seismic waves

What questions are the observations intended to answer?
Used to locate earthquakes, record their radiation patterns and study the seismic structure of the earth in the NEPTUNE region.

Who is responsible for specification of the observing system?
NEPTUNE seismic team

Who are expected to be the initial users of data from this observing system?
University scientists and Geological Survey of Canada scientists

Is there a specific feature or site where the observing system must be located?
Near all proposed nodes and on Explorer and Pacific Plates

What is(are) the nearest NEPTUNE Canada node(s)?
Nootka Fault, Explorer, Middle Valley, Endeavour, Pacific Plate, ODP 1027, Poseidon Deep and IOD Deep. At Endeavour site we would also propose an array of short period seismographs to support the ridge studies.

How far is this from the observing system site?
Explorer and Pacific sites are 50-75km from proposed nodes.

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
In-situ sensors

How often will measurements be taken?
continuous

Will this change according to conditions, and how?

no

What are the consequences of interruptions of a few hours, a day, several days, a month*?

Data will be stored on site and recovered automatically, in order of priority. This routinely done in the Canadian National Seismograph Network (CNSN).

How often will the raw measurements be transmitted to shore, and in what format?

Continuously in a data stream of time stamped packets

How many bytes of data may be expected in each transmission?

Standard packets would have about 16,000 bytes. Data transmission rates are kilobits per second in normal operational mode. Data rates can increase by up to an order of magnitude during "catch up mode" after an interruption.

What is required to transform the raw measurements into meaningful units?

Standard software used in land based seismic networks.

What format is planned for the data in meaningful units?

One of several standard international formats

Is there a commonly accepted standard and what is it?

MiniSEED is one of the most common.

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?

Regular automatic calibrations by existing software.

How will these corrections be determined*?

By existing software

How often will they need to be changed*?

Only if new noise sources affect the site

Who will be responsible for calibration corrections*?

Suggested that the Geological Survey of Canada, who operates the CNSN.

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)

All data

Who will be responsible for monitoring the quality of the real-time data?

Suggested Geological Survey of Canada using existing CNSN software.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?

Data from land based CNSN

What real time NEPTUNE data not provided by this observing system will be needed for the research?

Data from land based CNSN

If the complete calibrated data is not available in real time, when will it be available to other users?

N/A

Who will be responsible for quality control of ‘final’ data to be stored in the NEPTUNE DMAS and other disciplinary repositories?

Suggested Geological Survey of Canada using existing CNSN software

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Is there an existing disciplinary repository for archived data?

Yes, Geological Survey of Canada and IRIS in the United States

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)

Each time stamped data packet contains a header with information about: name location, data channelamplification, etc. which must be linked to a database where that information is retrievable. That data base and the tools to use already exist with the Geological Survey of Canada.

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?

On, off, levelling, calibration, reboot

What events might require action?

Hangup of onsite computer (rare).

What information will be needed to make decisions to initiate an action?

Non performance detected by automatic software

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?

N/A

What is the expected format of commands (e.g. serial sequences, web-based frames)?

Serial sequences

What will be the amount and rate of information exchange during a controlled action?

Small data rates to remote station to activate onsite software.

Section 4: Communications

How often will the observing system communicate with shore?

A continuous stream of time stamped data packets.

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?
Each packet will have something like 16,000 bytes depending on format chosen

If variable, what are the expected maximum and minimum?

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)

Probably TCP/IP

What will be the message format?

One of several standard formats will be chosen

What will be the impact of a planned interruption in communication, e.g. planned network service?

Onboard storage and retransmission when communication is returned (standard software

What is planned to minimize the impact?

As above

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?

As above

What is planned to minimize this impact?

As above

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?

never

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?

millisecond

How frequently will the instrument need to receive a time signal?

Something like once per minute

What is the best format for the time signal?

Some international standard, like that provided by GPS

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)

milliseconds

What are the consequences of an interruption in the time signal?

System will carry time on internal clock.

Section 6: Power

What voltage is the observing system expecting from the network?

Depends on hardware selected, typically 12 volts

What is the minimum current required?

Depends on hardware selected, power consumption typically 10 watts or less.

What fraction of the time will the observing system be drawing the minimum?

What is the maximum current required (e.g. for motors, lights)?

How often will this be needed and for how long each time?

System does not have significant power fluctuation demands

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?

System will have battery backup with automatic switchover.

What is planned to minimize the impact?

As above

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?

As above

What is planned to minimize this impact?

As above

Section 7: Emissions and sensitivity

Will the observing system emit **sound**?

No

What will be the source and nature of the **sound**?

What frequencies and power levels?

How often?

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?

What power levels, frequencies or other characteristics would result in interference?

Will the observing system emit **light**?

No

What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**?

No

What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

Yes.

What characteristics will cause vibration to interfere?

Any vibration or ground motion with frequencies of up to 100 Hz and down to very long periods of abut 300 seconds will affect the seismographs.

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?

No.

What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?

No

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments?

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?

No

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**

No

What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?

No

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?

No

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)

Standard security procedures and firewalls such as used by the Geological Survey of Canada's CNSN

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?

As above

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?

Don't know. Need to know what precautions should be taken.

How, where and when will the observing system be tested to establish its reliability*?

MARS and VENUS

Has a reliability analysis been conducted?

Not on an underwater system. However, The Geological survey of Canada's land based CNSN seismic observatories are very reliable.

What is the probable failure rate?

No numbers available for an underwater system.

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?

Embedded in the sea floor

Does the sea floor need to have particular characteristics?

Yes

What? *Both sediment site and bedrock sites are considered.*

What other characterstics should the site have?

Away from vibration.

Will it be self-contained or is it expected to mount on or in another structure?

Both.

Does this structure already exist (e.g. ODP borehole)?

Where boreholes are available, deployment n boreholes is desirable.

Will it require assembly on the seafloor, other than plugging in the cable and connector?

No, but the seismometer must be buried with a cable to the data logger and power supply.

How big is it likely to be (height, width, depth, weight)?

Depends on instruments chosen. About a cubic metre and 100kg would be a reasonable guess.

How accurately will it have to be positioned (horizontal, vertical, orientation)?

+/- 10 metres

Does it require protection from biofouling?

No

What is planned?

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?

Decision not made, probably through an "Extension Cord"

How far is it likely to be from a Science Node?

Depends on local vibration sources at the node. Could be within a few metres if no vibration or up to 10km if there is a serious vibration problem.

What are the impacts of a planned interruption to the connection to the network*?

None, software will automatically recover data.

What are the impacts of an unplanned interruption to the network connection*?

None, software will automatically recover data if interruption does not exceed design criteria

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?

Both self-contained and borehole installations

Does this structure already exist (e.g. ODP borehole)?

Yes, boreholes exist near some proposed nodes

Will it require assembly on the seafloor, other than plugging in the cable and connector?

No.

How accurately will it have to be positioned (horizontal, vertical, orientation)?

10 metres horizontally

What are expected (planned) servicing requirements?

Replace battery pack

What will need to be done?

Unplug and plug in new battery pack with ROV

How often?

Depends on batteries chosen (typically 1-3 years).

How long will it take?

Don't know

Who will be responsible for the costs?

Hopefully NEPTUNE Canada

How far in advance must the servicing schedule be known to have minimum impact on use of the data?

Hours to Days

Will emergency servicing be expected if the observing system fails?

Yes, to replace instrument

Who will be responsible for the decision?

To be determined

Who will be responsible for the cost?

To be determined

Section 12: Documentation

What documentation is available?

No specific documentation exists yet. However, the NEPTUNE Canada seismic network will be an extension of the land seismic network and the NEPTUNE Canada seismic observatory system will be likely be a packaging of commercial instruments that exist for land deployment for which there are extensive documentation.

on the science plan

None exists yet

on the sensors and measurement techniques

Sensors will be those commercially available for land deployment so ample information is available.

on the design and specification of the observing system

the observing system will be similar to those used on land at remote seismograph observatories packaged for function on the ocean bottom., so documentation exists. The ocean bottom packaging will likely be a derivative of an existing self contained ocean bottom seismograph for which documentation exists.

What information and documentation will be needed?

Documentation of final instrument package will need to done, particularly the cable connection aspects.

Observing System 2 : Geodetic Monitoring of Plate Motion

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Geodetic Monitoring of Motions and Deformation of the Juan de Fuca Plate System

Person to contact for information:
Herb Dragert / Dave Chadwell

Purpose of the observing system:
Continuous, real-time measurement and monitoring of seafloor crust that is actively being deformed by ridge-crest, transport, and subduction processes. The NEPTUNE Canada cable, along the northern Juan de Fuca plate, provides the unique opportunity to provide both continuous, real-time measurements and a transect across a plate spreading center (Endeavour Segement of the Juan de Fuca Ridge), a oceanic plate (JDF,) and a oceanic-continental plate convergent margin (Cascadia subduction zone).

What questions are the observations intended to answer?

1. *What are the contemporary rates & directions of motion for the Juan de Fuca plate?*
2. *What is the contemporary rate of spreading across the Juan de Fuca Ridge?*
3. *What are the spatial variations in crustal motions (i.e. the crustal deformation) of the Juan de Fuca Plate system?*
4. *What is the relationship of plate motions/deformations to earthquake activity?*
5. *Do transient motions (hours to weeks) exist and what is their nature and impact?*
6. *How is plate stress redistributed as a result of seismic and aseismic crustal motions at the spreading centres and the subduction zone?*

Who is responsible for specification of the observing system?
Dave Chadwell, Herb Dragert, Stephane Mazzotti, (plus others)

Who are expected to be the initial users of data from this observing system?

1. *Scientists trying to understand the detailed dynamics of the Juan de Fuca Plate System and processes involved at divergent and convergent margins*
2. *Agencies responsible for determining the seismic hazard along the Cascadia margin*

Is there a specific feature or site where the observing system must be located?

Feature	***NODE***
Pacific plate	*Pacific*
Ridge crest and flank	*Endeavour*
Mid-plate site	*ODP 1027*
Deformation front	*IODP DEEP*
Continental slope	*ODP889*
Continental shelf	*Poseidon Shallow*

How far is this from the observing system site?

Feature	***NODE***
Pacific plate: (1)	*Pacific*
Ridge crest and flank (2)	*Endeavour*
Mid-plate site: (1)	*ODP 1027*
Deformation front: (3)	*IODP DEEP*
Continental slope: (3)	*ODP889*
Continental shelf: (4)	*Poseidon shallow*

Notes:

1 – Currently envisioned to have four precision seafloor transponders at the corners of a square where each side of the square is approximately 3.5 km (water depth multiplied by 1.4). Currently expect these to be cabled to the node preferably for both power and telemetry, but higher priority being power.

2 - Will have 8-12 precision seafloor transponders spaced approximately 1-2 km along a line that begins just outside the axial valley and continues east down the flank until reaching significant sediment cover (~18-20 km). Also interspaced within this same line are 8-12 interrogation units moored some tens to hundred meters off the seafloor. Desire that both types of units to be connected to the cable for both power and telemetry. Minimal arrangement would be having power and telemetry to the interrogation units.

3 - Again have four precision seafloor transponders at the corners of a square where each side of the square is approximately 2-3 km (water depth multiplied by 1.4). Currently expect these to be cabled to the node preferably for both power and telemetry, but higher priority being power. Also interspaced within the square are 4 interrogation units moored some tens to hundred meters off the seafloor. Desire that both types of units to be connected to the cable for both power and telemetry.

4 – Have four precision seafloor transponders at the corners of a square where each side of the square is approximately 500 m (water depth multiplied by 1.4). At this site have a 3-m surface buoy moored over the transponder array. In addition to power and telemetry for the seafloor units, expect both power and telemetry for buoy instruments to come up from the seafloor to the buoy.

Section 2: Data

What is the nature of measurments:
Acoustic (10-15 kHz, 100 kHz) travel time measurements over ranges up to several kms and precision kinematic GPS positioning of surface hydrophone mounted to ship or buoy.

How often will measurements be taken?
Acoustic range duty cycle is selectable, but nominally 1-2 times per minute. GPS will be recorded at 1-5 Hz.

Will this change according to conditions, and how?
Yes, may increase rate of acoustic ranging during times when other sensors (seismic, water temperature, bore hole pressure) indicated possible tectonic activity.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Critical if this occurs during an "event" when seafloor motion is concentrated. We may consider in situ power, data buffer to operate autonomously during these outages. [This means just retaining capabilities that are currently part of these type of instruments which have been originally designed to be autonomous and battery operated.]

How often will the raw measurements be transmitted to shore, and in what format?
For acoustic measurements two possibilities exists: One, is to send back to shore over the fiber small snippets of raw acoustic data (a few-millisecond-long recording every 20 seconds) for processing onshore. Two, reduce acoustic data to a simple travel-time measurement of a few ASCII characters using in situ processing at each acoustic ranging unit.

How many bytes of data may be expected in each transmission?
About one order of magnitude less than a seismometer. We will attempt to quantify this more precisely in the near future.

What is required to transform the raw measurements into meaningful units?
Several processing steps will need to be completed onshore. These approaches already exist and it is a matter of configuring a processing capability to handle continuous, near real-time data.

What format is planned for the data in meaningful units?
TBD

Is there a commonly accepted standard and what is it?
GPS data will be stored in its raw binary format (which is dependent on the receiver manufacturer) and also in RINEX format, which is the internationally accepted standard; no agreed upon standard is known for the acoustic data, but can be developed.

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
TBD

How will these corrections be determined*?
TBD

How often will they need to be changed*?

TBD

Who will be responsible for calibration corrections*?
TBD

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
The "acoustic strainmeter" data observed at the ridge can be made available in real time to indicate major strain events.

Who will be responsible for monitoring the quality of the real-time data?
TBD

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
For GPS data processing, extremely precise GPS satellite positions will be needed. These are routinely provided by the global scientific community (IGS) and will not require additional resources. The positions of the land GPS reference stations need to be monitored as accurately as possible. This will be enabled through existing GSC infrastructure

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Measurements of seawater sound speed (or temperature) will be included as needed as part of the observing system (i.e., will design a self-contained system), but any measurements from other systems could potentially be exploited.

If the complete calibrated data is not available in real time, when will it be available to other users?
TBD, but likely data will be available real-time.

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
TBD.

Is there an existing disciplinary repository for archived data?
YES for GPS data. Yes for the acoustic data, but held by one PI, not yet a community repository. This and accompanying standards will need to be agreed upon, but this is a tractable problem.

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Time stamp +- 1 microsecond

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Change sample rates.

What events might require action?
Tectonic events

What information will be needed to make decisions to initiate an action?
Time series from the observing system and/or seismic, temperature sensors, etc.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
Seconds, but not too critical

What is the expected format of commands (e.g. serial sequences, web-based frames)?
TBD, but likely both with some mix between the various instruments.

What will be the amount and rate of information exchange during a controlled action?
TBD, but likely small (one or two orders of magnitude less) compared to HDTV and seismometers.

Section 4: Communications

How often will the observing system communicate with shore?
Possibly data packets to shore continuously.

What is the maximum expected interval between communications?
TBD, but hopefully a few seconds to minutes.

The minimum?
TBD, but on order of seconds

How much information (bytes) will each communication include?
TBD, but much less than HDTV and still less than a seismometer.

If variable, what are the expected maximum and minimum?
TBD

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
TBD-all are possibilities.

What will be the message format?
TBD

What will be the impact of a planned interruption in communication, e.g. planned network service?
See next.

What is planned to minimize the impact?
Can configure for temporary onboard autonomous operation.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?

What is planned to minimize this impact?
Can consider a ring buffer on each unit that retains data until it is deposited into the onshore data bank.

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Not very frequently over the fiber. Will likely be a limited user of this capability

What is the maximum expected interval between communications?
TBD
The minimum?
TBD

How much information (bytes) will each communication include?
TBD

If variable, what are the expected maximum and minimum?
TBD

What will be the message format?
TBD

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
Planned microsecond level should be appropriate

How frequently will the instrument need to receive a time signal?
TBD

What is the best format for the time signal?
TBD

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
MICRO

What are the consequences of an interruption in the time signal?
TBD

Section 6: Power

What voltage is the observing system expecting from the network?
12VDC

What is the minimum current required?
Few milliamps, for acoustic instruments, 10-15 Watts for GPS receivers topside.

What fraction of the time will the observing system be drawing the minimum?
While acoustic system operating

What is the maximum current required (e.g. for motors, lights)?
TBD

How often will this be needed and for how long each time?
TBD

Is there any intermediate level of current requirement?
TBD

If so, how much, and what fraction of time?
TBD

What will be the impact of a planned interruption in power, e.g. planned network service?
TBD

What is planned to minimize the impact?
Perhaps in situ battery

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
Interruption to data collection and time series. This is probably not catastrophic for the instruments themselves.

What is planned to minimize this impact?
TPB

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *YES*
What will be the source and nature of the **sound**? *Acoustic hydrophone*

What frequencies and power levels? *Nominally 15 kHz at 160 db*

How often? *TBD, but a few times per day minimum*

What is the duration of the **sound**s? ~ *10-15 Milliseconds*

If directional, how will it be directed? *N/A*

Will sound from other sources interfere with measurements by the observing system? *Potentially.*

What power levels, frequencies or other characteristics would result in interference? *Signals in the 10-15 kHz band, potentially a problem.*

Will the observing system emit **light**? *NO*
What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**? *NO, except perhaps the buoy.*
What will be the cause and nature of the **vibration**? *Wave motion strum.*

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
What will be the cause of the **turbidity**? *NO*

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *NO*

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments?

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *NO*

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *Locally, within a few meters of the transponders*

What will be the cause and nature of these currents or gradients?
Power amps in the transponder systems.

What characteristics? *TBD*

How often? *TBD*

What is the duration of the electrical effects? *TBD,*

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements? *Unlikely to that close to other sensor*.

What characteristics will cause interference?

Are there any **other potential sources of interference**? *NONE KNOWN*

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Sites on the shelf, may be subject to this.

What precautions are planned against damage by fishing?
Plan to include trawl-proof housing and buoy with perhaps secondary marker buoys will act as a guard.

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Will keep user facility behind a firewall

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Usual system admin approaches including total separation of archives from user-accessible storage

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
Power and telemetry will be isolated.

How, where and when will the observing system be tested to establish its reliability*?
TBD, but already a long history (10+ years) with the acoustic components and the GPS component aboard ships. Main issue of reliability will be the buoy mooring and cable issues common to all other sensors.

Has a reliability analysis been conducted?
NO

What is the probable failure rate?
TBD

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Some will sit on the seafloor, some in the water column and perhaps one on the surface.

Does the sea floor need to have particular characteristics? *TBD,but likely no.*

What?

What other characterstics should the site have? *TBD, likely can accommodate most both rocky and sediment environments.*

Will it be self-contained or is it expected to mount on or in another structure? *Self contained, except the buoy installation*

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector? *NO*

How big is it likely to be (height, width, depth, weight)?
Nominally the size of conventional seafloor transponders; the optimal size for the protective frame for shallow deployed units TBD; GPS-buoy a 3-m diameter surface buoy.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
A few meters.

Does it require protection from biofouling? *Modest*
What is planned? *TBD*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
Nominally, this will be near (100 meters to kms) of a node, and will likely be connected via a SII.

How far is it likely to be from a Science Node? *See above*

What are the impacts of a planned interruption to the connection to the network*? *TBD*

What are the impacts of an unplanned interruption to the network connection*? *TBD*

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
Self-contained.

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector? *NO*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
A few meters to 10s of meters.

What are expected (planned) servicing requirements?

What will need to be done*? Acoustic instruments should operate without maintenance for several years. Buoy will need annual servicing of a couple of days to check mooring, etc.*

How often? *See above*

How long will it take? *See above*

Who will be responsible for the costs? *TBD*

How far in advance must the servicing schedule be known to have minimum impact on use of the data? *Does not appear to be an issue.*

Will emergency servicing be expected if the observing system fails? *TBD, but if buoy mooring breaks and it begins to drift will need an emergency recovery.*

Who will be responsible for the decision? *TBD*

Who will be responsible for the cost? *TBD*

Section 12: Documentation

What documentation is available? *Some, but it is being assembled.*

on the science plan *Being developed*.

on the sensors and measurment techniques. *Exists in the form of journal articles, technical reports and some user manuals.*

on the design and specification of the observing system *Being developed*.

What information and documentation will be needed?

Observing System 3: Tsunamis and Storm Surges

Section 1. Overview of Purpose and Interests

Name or title of the observing system*: Real-time observations and modelling of tsunamis and storm surges off the West Coast*

Person to contact for information: *Josef Cherniawsky*

Purpose of the observing system:
Observations of tsunami and storm surge waves

What questions are the observations intended to answer?

1. *What are the general properties and behaviour (wavenumber/frequency content, orientation, refraction by bathymetric features, growth and transformation) of tsunami waves in the deep ocean and on the shelf, as measured by the Neptune array of bottom pressure recorders (BPRs) and coastal tide gauges?*
2. *How sensitive are these models to varying BPR array geometry (by removing some array elements) or to earthquake location, parameters and scenarios?*
3. *Which earthquake models give the best agreement with observations?*
4. *What is the best way to use numerical models to reproduce these observations?*
5. *Can such models be designed to display simultaneous high-resolution results in multiple harbours and/or inlets?*
6. *What are the generation and propagation properties of ocean swells and other long waves (such as shelf waves) generated by local and remote synoptic storms?*
7. *What are the statistical and physical properties of storm-generated swells in the deep ocean, as compared to shallow seas?*
8. *How accurate can be and what are the limitations of the modern tsunami models for simulating storm-generated deep-ocean long waves, their propagation onto the shelf and run-up in harbours and inlets?*
9. *How essential is to parameterize surface gravity wave physics (and to what degree of detail) for simulation of oceanic swells?*

Who is responsible for specification of the observing system?
Thomson, Gonzales, Davis, Cherniawsky.

Who are expected to be the initial users of data from this observing system?
(1) Early-tsunami detection and warning systems in Canada and US and provincial (BC) and state (WA, OR, CA) emergency preparedness authorities, (2) tsunami and storm surge research scientists, (3) educational institutions using such data for training.

Is there a specific feature or site where the observing system must be located?

This project will use most, if not all, of the BPRs deployed at sea bottom by other project teams, with possible addition of up to 3 instruments. (1) The spatial extent of these BPRs should be as large as possible, with some of them to be located on the shelf. (2) It is very desirable (for maximum utilization by various scientific disciplines) that some BPRs be located exactly at altimeter tracks, and even better, at track crossovers (a map was provided in the end as Fig. 1). High-precision radar altimeters on TOPEX/Poseidon and Jason-1 (TPJ) satellites have been measuring sea level anomalies since 1992 with a nominal precision of up to 2 cm. Jason-2 will be launched in 2007/08 with expected life time of at least 5 years.

What is(are) the nearest NEPTUNE Canada node(s)?
If no re-location is possible of the planned node locations, then additional BPRs can be deployed at Jason-1 crossovers (1) near ODP 1027, (2) NE of Poseidon Shallow, (3) south of the Explorer node (see Fig. 1). If the Explorer node can be shifter to nearest TPJ track either to the east or to the west, then the 3rd BPR may not be needed. An interesting site may at TPJ location NE of Middle Valley, with a possibility to combine long-term surface (TPJ) and near bottom observations near one of the hot vents.

How far is this from the observing system site?
An average distance is about 20 km. As a minimum, we will consider adding a BPR at a single TPJ location that is very close (< 5 km) to ODP1027, instead of the TPJ crossover SE of it.

Section 2: Data *(most of these questions will be answered by people who plan to deploy the bottom pressure recorders)*

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Bottom pressure recorders.

How often will measurements be taken?
At 1 sec. (1Hz), or better. These are very low data rates compared to other instruments.

Will this change according to conditions, and how?
No, unless requested by others.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Not critical, unless (by sheer chance) a tsunami moves in during this period.

How often will the raw measurements be transmitted to shore, and in what format?
Real-time,

How many bytes of data may be expected in each transmission?
??? (I need to check with Earl Davis)

What is required to transform the raw measurements into meaningful units?

???

What format is planned for the data in meaningful units?
???

Is there a commonly accepted standard and what is it?
???

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units? *???*

How will these corrections be determined*?
???

How often will they need to be changed*?
???

Who will be responsible for calibration corrections*?
Earl Davis (and other scientists who deploy these BPRs).

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
All of it, as far as this proposal is concerned.

Who will be responsible for monitoring the quality of the real-time data?
Josef Cherniawsky, Earl Davis, or other assigned person.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Atmospheric analyses (surface winds, pressure), satellite altimetry (Jason-1, Jason-2), coastal tide gauge data (DFO, NOAA).

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Current meter and CTD data from profiling or fixed moorings.

If the complete calibrated data is not available in real time, when will it be available to other users?
N/A

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Cherniawsky, or another designated person.

Is there an existing disciplinary repository for archived data?
MEDS (DFO)

What information should be included in meta-data from this observing system? (The NEPTUNE data policy will include requirements, but these are still under development)
???

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Replace failed instruments.

What events might require action?
Instrument failure.

What information will be needed to make decisions to initiate an action?
At least 1-day long period of no useful data stream.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
N/A

What is the expected format of commands (e.g. serial sequences, web-based frames)?
The BPRs should be always ON.

What will be the amount and rate of information exchange during a controlled action?
N/A

Section 4: Communications

How often will the observing system communicate with shore?
???
What is the maximum expected interval between communications?
???
The minimum?
???
How much information (bytes) will each communication include?
???
If variable, what are the expected maximum and minimum?
???
What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
???
What will be the message format?
???
What will be the impact of a planned interruption in communication, e.g. planned network service?
No serious impact, as long as the data are logged and transmitted when communications resume.

What is planned to minimize the impact?
Data logger (???).

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Not serious, unless a tsunami arrives at this time.

What is planned to minimize this impact?
Data logging.

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites? *N/A*

What is the maximum expected interval between communications?
???

The minimum?
???

How much information (bytes) will each communication include?
???

If variable, what are the expected maximum and minimum?
???

What will be the message format? *???*

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
0.1 sec is sufficient.

How frequently will the instrument need to receive a time signal?
???

What is the best format for the time signal?
???

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
milli

What are the consequences of an interruption in the time signal?
Depends on how long the interruption is. Time drift in data logger may result in errors in wave (phase) characteristics.

Section 6: Power

What voltage is the observing system expecting from the network?
???
What is the minimum current required?
???
What fraction of the time will the observing system be drawing the minimum?
???
What is the maximum current required (e.g. for motors, lights)?
???
How often will this be needed and for how long each time?
???
Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
???
What will be the impact of a planned interruption in power, e.g. planned network service?
Loss of data (unless there is battery backup)

What is planned to minimize the impact?
???

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
Loss of data (unless there is battery backup)

What is planned to minimize this impact?
???

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? **No**
What will be the source and nature of the **sound**?

What frequencies and power levels?

How often?

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?
No, unless it is a very powerful source.
What power levels, frequencies or other characteristics would result in interference?
???

Will the observing system emit **light**? **No**

What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**? ***No***
What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?
Yes
What characteristics will cause vibration to interfere?
Changes in bottom pressure, even if small, will interfere (alias) with wave measurements.
Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *No*.
What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem? *No*.

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *No*.

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments? *No*.

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *No*.

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? *No***.**

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *No***.**
What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements? **???**

What characteristics will cause interference?

Are there any **other potential sources of interference**? **???**

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Yes (if BPRs are deployed on the shelf).

What precautions are planned against damage by fishing?
Protective housing. ***???***

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
N/A

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
DFO and NRCan have system-wide virus-protection.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?

How, where and when will the observing system be tested to establish its reliability*?
BPRs were deployed and tested already.

Has a reliability analysis been conducted? ***???***

What is the probable failure rate? ***???***

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Embedded in the sea floor.

Does the sea floor need to have particular characteristics? *Yes*

What? *Stable platform*.

What other characterstics should the site have? **???**

Will it be self-contained or is it expected to mount on or in another structure?
???

Does this structure already exist (e.g. ODP borehole)?
Some do.

Will it require assembly on the seafloor, other than plugging in the cable and connector? *No.*

How big is it likely to be (height, width, depth, weight)?

How accurately will it have to be positioned (horizontal, vertical, orientation)?

Does it require protection from biofouling?
What is planned?

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an ‘Extension Cord”?
2-3 BPRs will be on “extension cords”.

How far is it likely to be from a Science Node?
3-15 km

What are the impacts of a planned interruption to the connection to the network*?
Minimal, if data are logged and no tsunami comes by.
What are the impacts of an unplanned interruption to the network connection*?
Same.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
???

Does this structure already exist (e.g. ODP borehole)?
In some cases. ***???***

Will it require assembly on the seafloor, other than plugging in the cable and connector? ***No.***

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Final positions should be measured with GPS in all directions. The actual positioning is not critical.

What are expected (planned) servicing requirements?
Yearly.

What will need to be done?
\Servicing/calibration/replacement of failed instruments

How often? At least once a year. **???**

How long will it take? **???**

Who will be responsible for the costs? **???**

How far in advance must the servicing schedule be known to have minimum impact on use of the data? **???**

Will emergency servicing be expected if the observing system fails? **???**

Who will be responsible for the decision? **???**

Who will be responsible for the cost? **???**

Section 12: Documentation

What documentation is available?
Some documentation exists on BPRs (check with Earl Davis)

> on the science plan*: (1) draft proposal, (2) power point presentations, (3) refereed publications on tsunami measurements and modelling and on altimetry data, (4) web pages on tsunami research at IOS and PMEL.*
>
> on the sensors and measurment techniques
>
> on the design and specification of the observing system

What information and documentation will be needed?

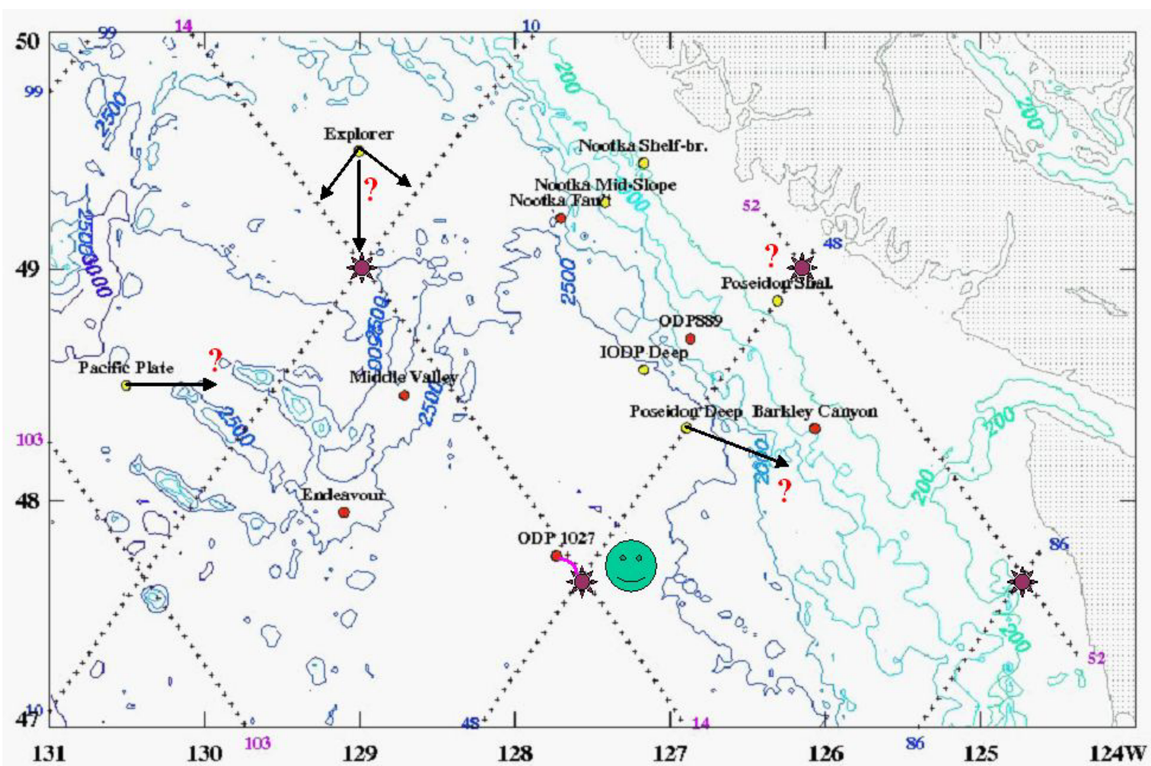

Figure 1: Locations of Neptune experimental sites relative to TOPEX/Poseidon/Jason altimeter tracks. Certain track crossovers were marked to show desirable locations of shared or extra BPRs.

Theme 2 Dynamic Processes of Fluid Fluxes and Gas Hydrates in the Seabed

Observing System 1 Hydrate: physical, geophysical, geochemical & biological, microbial

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Hydrate: physical, geophysical, geochemical & biological, microbial
Person to contact for information:
Dr. Ross Chapman chapman@uvic.ca
Purpose of the observing system:
Extract from first section of proposal

What questions are the observations intended to answer?
extract

Who is responsible for specification of the observing system?
List contact points
Who are expected to be the initial users of data from this observing system?
Hydrate research team and community

Is there a specific feature or site where the observing system must be located?
Three sites - BV, ODP, BC [Nootka]

What is(are) the nearest NEPTUNE Canada node(s)?
BC, ODP, Nootka

How far is this from the observing system site?
[up to 5km]

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Digital still; in situ sensors - physical samples; acoustic; seismic; chemical sensors (CH_4, O_2, SO_4)

How often will measurements be taken?

Will this change according to conditions, and how?
Yes, response to episodic events

What are the consequences of interruptions of a few hours, a day, several days, a month*?

How often will the raw measurements be transmitted to shore, and in what format?

How many bytes of data may be expected in each transmission?

What is required to transform the raw measurements into meaningful units?

What format is planned for the data in meaningful units?

Is there a commonly accepted standard and what is it?

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?

How will these corrections be determined*?

How often will they need to be changed*?

Who will be responsible for calibration corrections*?

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)

Who will be responsible for monitoring the quality of the real-time data?

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Hydrophones, OBS. Water column oceanography

If the complete calibrated data is not available in real time, when will it be available to other users?

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?

.
Is there an existing disciplinary repository for archived data?
No

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Rover/crawler movements in response to episodic events
Change in fixed schedule: seismic/acoustic; cameras;
No change for borehole instruments

What events might require action?
Earthquakes; slumps; slides; tsunamis
Oceanographic changes in pressure and temperature

What information will be needed to make decisions to initiate an action?
Thresholds exceeded for: OBS, ground acceleration ; CH_4 concentration

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
Ask Ian: etc; / rover about 0.1s

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Digital sequences; ?

What will be the amount and rate of information exchange during a controlled action?
?

Section 4: Communications

How often will the observing system communicate with shore?
See schedule of operations (in proposal, not yet available) for each instrument

What is the maximum expected interval between communications?
See schedule
The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)

What will be the message format?

What will be the impact of a planned interruption in communication, e.g. planned network service?
Likely can accommodate

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Not likely any damage to passive systems; maybe recalibration and stabilization is necessary

What is planned to minimize this impact?

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
10µs

How frequently will the instrument need to receive a time signal?
250µs

What is the best format for the time signal?
Standard NMEA

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)

What are the consequences of an interruption in the time signal?

Section 6: Power

What voltage is the observing system expecting from the network?
Likely 48V for crawler; Sound source?; EM source 400V?

What is the minimum current required?
?
What fraction of the time will the observing system be drawing the minimum?
?
What is the maximum current required (e.g. for motors, lights)?
?
How often will this be needed and for how long each time?
?
Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
?

What will be the impact of a planned interruption in power, e.g. planned network service?
See above

What is planned to minimize the impact?
Calibration should be made from shore

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
See above
What is planned to minimize this impact?

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes*

What will be the source and nature of the **sound**?
Rovers; sound source pumps, rotation camera

What frequencies and power levels?
<10hz >20hz

How often?
? see schedule

What is the duration of the **sound**s?
Rover: time as it moves same for others

If directional, how will it be directed?
Maybe for the sound source

Will sound from other sources interfere with measurements by the observing system?
Possibly detection of noise in OBS, pressure guage

What power levels, frequencies or other characteristics would result in interference?
Not yet known

Will the observing system emit **light**? *Yes:*

What will be the source and nature of the **light**?
Strobe (white), Laser (blue-green)

What colour and power levels?

How often? *See schedule*

What is the duration of the light? *See schedule*

If directional, how will it be directed?
Laser rotate 360^0

Will light from other sources interfere with measurements by the observing system?
No
What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**?
Yes

What will be the cause and nature of the **vibration**?
Rover

What frequencies and power levels?

How often?

What is the duration of the vibration?
Time of movement of crawler?

Will vibration from other sources interfere with planned measurements?
Yes – OBS noise

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
What will be the cause of the **turbidity**?
Crawler

How often and for how long?
minutes

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?
Yes, for camera

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
Lights; movement on sea floor; sound

What will be the cause and nature of the effect?
Electric fields, movement, sound, light

Are the planned measurement sensitive to effects on **the community** due to other experiments?

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
Yes
What will be the source and nature of the effect?
Release of natural gas and oil from sediment

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?
Hydrocarbon tracers etc.

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *Yes*

What will be the cause and nature of these currents or gradients?
EM measurement system; pulse of EM

What characteristics?
See schedule
How often? *See schedule*

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
Yes, EM system

What characteristics will cause interference?
Keep away from junction box and schedule carefully also keep away from profilers

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
BC; there is fishing around BC

What precautions are planned against damage by fishing?
Block area for fishing

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Passwords

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
No measures planned

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
EM – isolate electrically; hard reset to ensure shut off in catastrophic failure; hard reset for all instruments
How, where and when will the observing system be tested to establish its reliability*?
MARS, VENUS, cruises of opportunity

Has a reliability analysis been conducted?
All borehole experiments have been used

What is the probable failure rate?

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
All on seafloor; or close to interface of water/bottom borehole

Does the sea floor need to have particular characteristics?
Yes

What?
No obstacles (like carbonates); flat; bottom currents- mount/drill to seafloor

What other characteristics should the site have?
Depends on vulnerability of equipment. Do instruments need to be buried? Can fish damage instrument (octopus)? Bio-fouling?

Will it be self-contained or is it expected to mount on or in another structure?
More or less self contained

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector? *No*

How big is it likely to be (height, width, depth, weight)?
See list of instruments and responsible research. Exceptions ACORK, CORK II, DTS

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Very accurately positioned, position of moving crawler

Does it require protection from biofouling? *Yes*
What is planned? *Use special materials.*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
BV, BC on extension cord

How far is it likely to be from a Science Node?
< 5 km

What are the impacts of a planned interruption to the connection to the network*?

What are the impacts of an unplanned interruption to the network connection*?
Same as before, re-calibration

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
Self contained

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector? *No*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above

What are expected (planned) servicing requirements?

What will need to be done?
Retrieving water/bio samples from CORK II replace battery

How often?

How long will it take?

Who will be responsible for the costs?*Researchers/Neptune budget*

How far in advance must the servicing schedule be known to have minimum impact on use of the data?*Weeks*

Will emergency servicing be expected if the observing system fails? *Yes*

Who will be responsible for the decision? *PI's*

Who will be responsible for the cost? *PI's*

Section 12: Documentation

What documentation is available?
ODP – websites, publications

on the science plan *Proposal draft by Dr. Chapman* on the sensors and measurement techniques: *refer to people*

on the design and specification of the observing system

What information and documentation will be needed?
Where deployed
High-res mapping of site
Power requirements
Scheduling
What other experiments by other groups

Observing System 2 Water column properties at Endeavour Ridge

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Monitoring the "heart-beat" of a hydrothermal venting system: Real-time observations of water column properties at Endeavour Ridge

Person to contact for information:
Rick Thomson/Steve Mihaly

Purpose of the observing system:

What questions are the observations intended to answer?
Temporal and spatial variability of:
1) *the currents, water property structure, turbulence field, and optical properties of the lower 500m of the water column within the valley.*
2) *the distribution and aggregation of zooplankton, fish and other acoustic scatterers within the water column.*
3) *in vent-derived particle concentrations and size distributions.*
4) *in redox chemical species.*

and modeling the ridge and hydrothermal venting modulated effects on trophic level interaction below, within and above the vent plumes

Who is responsible for specification of the observing system?
Richard Thomson/Steven Mihaly, DFO
Russ McDuff, University of Washington
James Cowen, University of Hawaii
James Moum, Oregon State University

Who are expected to be the initial users of data from this observing system?
Richard Thomson/Steven Mihaly, DFO
Russ McDuff, University of Washington
James Cowen, University of Hawaii
James Moum, Oregon State University
Kenneth Denman, University of Victoria

Is there a specific feature or site where the observing system must be located?
Yes, the system is location dependant Assuming that the profiling system is (or isn't) available, we require a mooring south of Mothra, a mooring between Mothra and the Main Field, one between Main and Highrise and one north of high rise. Considering the high degree of cross valley flow velocity structure, the group also requested sites to the west and east of the Main Endeavour Field. We would prefer to have a profiler because we could then have several frequencies for better delineation of the flow velocity, zooplankton size structure and T-S fields. We could, however, default to moorings and

not do too badly. If the profiler is not available, we will require conventional bottom-linked moorings with MicroCat T/S/optical sensors at the sites of the ADCPs.

What is(are) the nearest NEPTUNE Canada node(s)?
Endeavour node

How far is this from the observing system site?
The node is proposed to be at this site

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
The measurements are taken by a combination of in-situ sensors and acoustic sensors

How often will measurements be taken?
The sampling will range from 1 second to hourly.

> Will this change according to conditions, and how?
> *No*

What are the consequences of interruptions of a few hours, a day, several days, a month*?
As in all data sets, data gaps are not desirable.

How often will the raw measurements be transmitted to shore, and in what format?
Real-time binary

> How many bytes of data may be expected in each transmission?
> *about 5Mb per hour in total transmissions*

What is required to transform the raw measurements into meaningful units?
Binary ASCII conversion

What format is planned for the data in meaningful units?
The ADCP, CTDs and other off the shelf instruments have their own individual header/leader body data format. There are no plans to modify the data into a single format.

> Is there a commonly accepted standard and what is it?
> *No.*

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?

Most of the instruments are either self calibrating or keep their calibration coefficients on board. Calibration can only occur when the instruments are in the lab.

How will these corrections be determined*?
See above.

How often will they need to be changed*?
This needs to be determined for each individual instrument, however we are planning for an initial 2-year deployment.

Who will be responsible for calibration corrections*?
The principal investigators

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
All the data.

Who will be responsible for monitoring the quality of the real-time data?
The principal investigators.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Wind/weather and climate data, ship data collected in the region, additional seismic data not collected by Neptune

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Seismic data

If the complete calibrated data is not available in real time, when will it be available to other users?

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
The principal investigators

.

Is there an existing disciplinary repository for archived data?
No

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Time, Instrument ID

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Currently there is no control incorporated. The instruments will have the capability to store the data and to run under their own battery power. NEPTUNE will be able to interrupt data and power supply for shorter periods of time without deleterious effect

What events might require action?
None anticipated at this time

What information will be needed to make decisions to initiate an action?

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?

What is the expected format of commands (e.g. serial sequences, web-based frames)?

What will be the amount and rate of information exchange during a controlled action?

Section 4: Communications

How often will the observing system communicate with shore?

> What is the maximum expected interval between communications?
> *Hourly*
>
> The minimum?
> *Second*

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?
A maximum 5Mb over the hour, if everything fails, zero

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
RS232. There may be a need to adapt a number of RS232 inputs to 100 Base T, with a junction box prior to the Neptune cable.

What will be the message format?
Each individual instrument has its format

What will be the impact of a planned interruption in communication, e.g. planned network service?

> What is planned to minimize the impact?

See above

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?

What is planned to minimize this impact?
See above

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Never

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
Time stamping will occur from the internal clocks of the instruments as well as an external time stamp from the shore station

How frequently will the instrument need to receive a time signal?
Never, at this phase

What is the best format for the time signal?

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)

What are the consequences of an interruption in the time signal?
None

Section 6: Power

What voltage is the observing system expecting from the network?
48V

What is the minimum current required?
20A

What fraction of the time will the observing system be drawing the minimum?

What is the maximum current required (e.g. for motors, lights)?
20A

How often will this be needed and for how long each time?

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?
See above

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
See above

What is planned to minimize this impact?

Section 7: Emissions and sensitivity

Will the observing system emit **sound**?
Yes
What will be the source and nature of the **sound**?
ADCPs Acoustic sounders

What frequencies and power levels?
75kHz, 150kHz, 400kHz, 750Khz
power levels are very low

How often?
Every second

What is the duration of the **sound**s?
ping duration, short milliseconds

If directional, how will it be directed?
vertical

Will sound from other sources interfere with measurements by the observing system?
No

What power levels, frequencies or other characteristics would result in interference?

Will the observing system emit **light**?
No
What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**?
No
What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
No
What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
Not any more than a regular autonomous mooring.

What will be the cause and nature of the effect?
Biofouling

Are the planned measurement sensitive to effects on **the community** due to other experiments?
No

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
No

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**
What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
No

What characteristics will cause interference?

Are there any **other potential sources of interference**?
No

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
No

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
The security measures of the participating Institutions

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
The security measures of the participating Institutions

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
It is designed to be independent and one way

How, where and when will the observing system be tested to establish its reliability*?
VENUS test bed

Has a reliability analysis been conducted?
No

What is the probable failure rate?

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
In the water column.

Does the sea floor need to have particular characteristics?
No

What?

What other characterstics should the site have?

Will it be self-contained or is it expected to mount on or in another structure?
Self-contained

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector? No

How big is it likely to be (height, width, depth, weight)?
500m 1m 2200m 300kg

How accurately will it have to be positioned (horizontal, vertical, orientation)?
It will be launched from a ship, like a regular mooring and then surveyed for precise location

Does it require protection from biofouling?
No
What is planned?

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
Extension cord

How far is it likely to be from a Science Node?
less than 4km

What are the impacts of a planned interruption to the connection to the network*?
None

What are the impacts of an unplanned interruption to the network connection*?
None

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
Self contained

Does this structure already exist (e.g. ODP borehole)?
No

Will it require assembly on the seafloor, other than plugging in the cable and connector?
No

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above

What are expected (planned) servicing requirements?

What will need to be done?
Recover the mooring.

How often?
2 Years

How long will it take?
1 week ship time

Who will be responsible for the costs?
Undetermined

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Minimal

Will emergency servicing be expected if the observing system fails?
No

Who will be responsible for the decision?

Who will be responsible for the cost?

Section 12: Documentation

What documentation is available?

on the science plan
As per science workshop September 2004

on the sensors and measurment techniques
Manufacturers documentation

on the design and specification of the observing system
As per science workshop September 2004

What information and documentation will be needed?
Technical design specification and documentation will be needed prior to deployment.

Observing System 2 Ridge Fluids, High Temperature

Component : Isosampler

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Isosampler
Person to contact for information:
Prof Adam Schultz, 104 COAS Admin Building, Oregon State University, Corvallis OR 97330
Purpose of the observing system:
Isosampler is a network-based, modular system for monitoring fluid flow rates and temperatures, for acquiring aqueous geochemical samples in a flexible set of 1-litre high pressure titanium sample bottles, for maintaining the pressure of the samples dynamically, for in situ and microbial incubation, and by addition of third party sensors, to carry out in situ geochemical and microbial analysis
What questions are the observations intended to answer?

- *To determine the flow rates (range: <1 mm/s-1m/s; resolution <1mm/s; accuracy <1 mm/s) and temperatures (range 0-500oC; resolution 0.1mdeg; accuracy 2 mdeg) at zones of hydrothermal and cold seep outflow*
- *To determine the time variations of those quantities over periods of 1 s – interannual, and to link these to driver processes including poroelastic response to tidal pressure forcing, tectonic, seismic and volcanic processes*
- *To determine the chemical composition of diffuse and high temperature hydrothermal fluids, and cold-seep fluids by acquiring 1-litre samples, and by maintaining them under isobaric sampling conditions; to link changes in chemical composition to (bio)geochemical processes*
- *To incubate microbial communities under isobaric conditions; to determine the presence of (obligate)extremophilic bacteria and archaea; to capture and analyze metabolites arising from microbial communities; and to model the interaction between the deposition and dissolution of mineral phases, and microbial mediation of reaction kinetics*
- *To examine correlations between wide-scale forcing functions and (bio)geochemical response*

Who is responsible for specification of the observing system?
Prof Adam Schultz
Who are expected to be the initial users of data from this observing system?
Subsurface flow modelers (geohydrological investigators); aqueous geochemists; microbiologists – particularly deep biosphere researchers

Is there a specific feature or site where the observing system must be located?
A fully-configured isosampler can operate with fluids up to 200oC (modifications to the flow/temperature sensor are possible that may allow us to increase this limit to black smoker temperatures). In its current configuration, the target areas are sites of

*fairly vigorous diffuse hydrothermal circulation (e.g. Endeavour Main Field – e.g. Easter Island site; S&M Site). Individual components of the system may also be used as high temperature autonomous and networked high temperature fluid samplers – e.g. various candidate smoker sites. The system may also be used in areas of vigorous hydrate-related flow***.**

What is(are) the nearest NEPTUNE Canada node(s)?

Endeavour main vent field

How far is this from the observing system site?

Proximate to other major science user sites at Endeavour

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?

In-situ sensors include a solid-state thin film flow sensor and temperature sensors, as well as a pressure sensor in each pressure-compensated fluid sample bottle; in addition pressurized fluid samples are obtained in 1-litre bottles. Third party sensors have been developed under separate NASA funding (in situ mass spectrometer, Mg sensor, methane sensor, fluorescent microbial detector) that MAY be integrated into this system, pending additional NASA funding (proposal for that is currently in review).

How often will measurements be taken?

Default sample rate is 10 s. Water samples are limited by number of bottles (typically one-to-six bottles per instrument). Water samples can be obtained on regular schedule, or in response to user intervention, or in response to events.

Will this change according to conditions, and how?

Isosampler is networked-enabled, making direct user intervention a possibility, via the Internet. Water samples can be triggered remotely, or in response to changes in flow rate, temperature, or in the event third party in situ sensors are installed, in response to chemical or biological events. Network communications make possible changes in sample rate or sample acquisition strategy in response to other, local, regional, or remote sensors, such as a local seismometer network.

What are the consequences of interruptions of a few hours, a day, several days, a month*?

Each subsystem of Isosampler is a stand-alone module, internally powered, and networked to all the other subsystems over a local area network. This, in turn, can be bridged out over the Internet via NEPTUNE. The system can be modified to permit recharging of internal power when NEPTUNE power is available. Each controller board which runs each subsystem, comes equipped with an SD memory card (presently available in up to 1 GB capacity). Consequently, Isosampler is extremely fault tolerant in event of NEPTUNE system down-time. Aside from the inability to issue remote commands to Isosampler, and from the interruption from the real-time data stream, all other functions will carry on internally, and all data will be logged without interruption, even for interruptions longer than one month.

How often will the raw measurements be transmitted to shore, and in what format?

We plan for real-time transmission using TCP-IP protocols, nominally involving both ASCII data transmission, and also – on demand – FTP download of discrete, internally archived data files (particularly in response to temporary interruptions in the NEPTUNE data backbone)

How many bytes of data may be expected in each transmission?

Data are recorded using 24 bit ADC, in a 32 bit format. For 10 s sampling, there are four channels of real-time data (without including 3rd party sensors mentioned previously). This is 96 bytes/minute plus header information (uncompressed), plus additional overhead for engineering data and command/control sequences. A maximum of 120 bytes/minute (2 bytes/second) can be expected for normal operations.

This could be increased if 1 Hz sampling is used, and if third party sensors are integrated – but even so outgoing data streams of 60 bytes/second seem a reasonable maximum in any circumstance.

Data telemetry will be asymmetric, with the greatest stream from the instrument-to-shore. Shore-to-instrument data transmission will often be nil, although relatively short command-control sequences can introduce episodic requirements for telemetry from short-to-instrument.

The worst case scenario would involve the total reprogramming of system ROM in the event a system bug was discovered after deployment. Isosampler does support in-circuit reprogramming of ROM. This would mean moving up to 64 Kbytes of data from shore on to each Isosampler subsystem (for a six bottle isosampler equipped with twelve titanium valves, two pressure compensators, one manifold pump and one flow/temperature sensor, this equates to sixteen separate controllers, each requiring 64 KB data transmission to reprogram ROM, or a total of 1 MB.) This would occur rarely or never and would not represent a significant load.

What is required to transform the raw measurements into meaningful units?

An intensive series of laboratory calibrations are required prior to deployment in order to tune the response of each flow/temperature sensor. The response of the flow sensor is logarithmic, and the temperature sensor is linear. Once so established, it is good practise periodically to recover a sensor to recalibrate it, particularly if biofouling is an issue. The other data are primarily geochemical and microbiological, and require laboratory analysis of physical samples; aside from possible third party sensors, which would benefit periodically from introduction of chemical blanks to prevent long-term drift from invalidating interpretations.

What format is planned for the data in meaningful units?

This has not yet been addressed beyond our own proprietary format. Given these are time series data, I see no impediment to adopting common time series format standards, e.g. SEED or others

Is there a commonly accepted standard and what is it?

Not yet – see above.

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?

It will be necessary to maintain a calibration laboratory (we are setting up a new one now) that has the ability to provide controlled flow rates (1 mms – 1 m/s, in 1 mm/s increments) and temperatures (2 deg to 90+ deg in 2 mdeg increments), and periodically to return sensors to the lab for recalibration. We would anticipate swapping out sensor elements during periodic service calls.

How will these corrections be determined*?

See above.

How often will they need to be changed*?

Ideally, every six months or less to start, but ultimately we'd aim for annual servicing, particularly if biofouling can be remediated.

Who will be responsible for calibration corrections*?

We would anticipate doing this.

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)

All time series data (flow rate, temperature, engineering status such as pressure in sample bottles) can be made available in real-time with the proviso that QC procedures following sensor recovery and recalibration may lead to changes in data values as long-term drift (if any) is removed.

Who will be responsible for monitoring the quality of the real-time data?

This is best done by our lab.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?

A full suite of physical oceanographic measurements would greatly benefit interpretation of the hydrological response to e.g. seafloor pressure changes, etc. Seismic, geodetic and electromagnetic data from the observatory site will assist greatly in understanding causal mechanisms for changes in flow physics and chemistry and concomitant changes in microbial response.

What real time NEPTUNE data not provided by this observing system will be needed for the research?

I think that EO satellite observations will be of benefit as we examine the source of plumes, and interactions with shallow waters.

If the complete calibrated data is not available in real time, when will it be available to other users?

The recalibrated, archival data should be available soon after annual laboratory sensor recalibrations.

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?

This is best done by our lab.

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Is there an existing disciplinary repository for archived data?

Not to my knowledge.

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)

Calibration constants for each sensor; sample rate; serial number of each sensor and each controller board; serial number of each valve; pump and sample bottle; latitude, longitude (both GPS), and water depth of installation; date of installation; date and short narrative of each service intervention; contact details of sensor and subsystem manufacturers; physical unit conversion algorithm for each sensor; narrative of instrument command/control description

<u>Section 3: Control</u>

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?

Ability to transmit data from each sensor in real-time; or to download internally stored data files using FTP protocol;

Ability to execute command/control commands from shore, actuating pump, fluid sampler, controlling individual valves – use of other networked devices (e.g. geophysical sensors to initiative sampling episode via NEPTUNE-transmitted commands);

Ability to return state-of-health and engineering status information to shore;

Ability to reprogram basic system ROM, in situ, in event of requirement for firmware upgrade

What events might require action?

Environmental events may require sampling trigger, or change of sample rate; e.g. magmatic dike injection, earthquake activity; floc emission

Engineering status information may indicate malfunction, requiring remote user intervention (reprogramming around faulty subsystems), or may trigger a service call requiring subsequent ROV time

What information will be needed to make decisions to initiate an action?

Knowledge both of isosampler system performance and engineering status information, and also access to other instrument's data streams from same observatory area – and potentially regionally-distributed instruments – to enable algorithms to be developed that would initiate e.g. a specific water sampling episode.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?

Manual remote intervention in drawing fluid samples through the inlet manifold, through a flow-through sample bottle, and out the outlet manifold, require coordination of several subsystems with 1-2 second accuracy.

What is the expected format of commands (e.g. serial sequences, web-based frames)?

Control will likely be web-based

What will be the amount and rate of information exchange during a controlled action?

Instrument-to-shore stream 2-60 bytes/second

Shore-to-instrument stream typically 256 byte frames, episodic and infrequent (sub 1 byte/second sustained)

Shore-to-instrument ROM reprogramming would require 1 MB total transmission, low speed acceptable.

Section 4: Communications

How often will the observing system communicate with shore?

Continuous 2-60 bytes/second in real-time mode

What is the maximum expected interval between communications?

Continuous TCP-IP – but can recover from sustained interruptions exceeding one month

The minimum?

0.5 second

How much information (bytes) will each communication include?

Instrument-to-shore 2-60 bytes/second

Shore-to-instrument 256 byte frames typical, 1 MB max transmission in extreme cases

If variable, what are the expected maximum and minimum?

See above

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)

Instrument will use TCP-IP protocols internally, over CANbus. Anticipate development of CANbus-to-ethernet interface, including wireless proximity options

What will be the message format?

Under development

What will be the impact of a planned interruption in communication, e.g. planned network service?

Loss of command-and-control, will default to pre-programmed operations mode

What is planned to minimize the impact?

All data logged internally by each subsystem, presently up to 1 GB buffer per controller board

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?

As above

What is planned to minimize this impact?

As above

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?

Peer-to-peer comms with other isosamplers will be possible – if two isosamplers at Endeavour, then continuous 2-60 bytes/second in real-time; Comms with other non-isosampler systems would likely be via algorithm operating shore-side – to be determined.

What is the maximum expected interval between communications?

To be determined

The minimum?

To be determined

How much information (bytes) will each communication include?

To be determined

If variable, what are the expected maximum and minimum?

Likely 2-60 bytes/second

What will be the message format?

TCP-IP protocols, specific format to be determined

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?

250 mSec

How frequently will the instrument need to receive a time signal?

At least monthly, daily or better preferred

What is the best format for the time signal?

TCP-IP transport encapsulated in packet with agreed header format

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)

milli

What are the consequences of an interruption in the time signal?

Clock drift exceeding 1 S/month, unless more expensive clock installed

Section 6: Power

What voltage is the observing system expecting from the network?

Isosampler works internally with a 3V processor core powered from a 5V input in present configuration, and with a small effort in redesign, could accept up to 18 V.

What is the minimum current required?

When not recharging internal cells – 0 amps. The pumps and valve controllers require approx 400 mA peak when operating, but they have a duty cycle of near zero; the flow/temperature sensor requires 45 mA, continuous

What fraction of the time will the observing system be drawing the minimum?

On average, there is a continuous requirement for powering the sensors, although external power could be interrupted and the system can run from internal cells that will then need recharging for time periods proportionate to the external power supply interruption.

What is the maximum current required (e.g. for motors, lights)?

The extreme peak requirements is the manifold pump, on start-up, which can require 1.2 A at 12 V.

How often will this be needed and for how long each time?

Peak current diminishes within several tens of milliseconds to the 400 mA level.

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?

Yes, perhaps once per month the 45 mA continuous requirement jumps to 845 mA for periods of about one minute, as two valves are opened, then 445 mA for another 5 minutes as fluids are pumped, then 845 mA for another minute as two valves are closed.

What will be the impact of a planned interruption in power, e.g. planned network service?

Minimum-to-none

What is planned to minimize the impact?

All subsystems are designed to run off of internal power, recharged when the network power is available.

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?

Minimum-to-none

What is planned to minimize this impact?

As above

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes*
What will be the source and nature of the **sound**?
Perhaps once per month, when a valve is opened or a pump started
What frequencies and power levels?
Not known. These are small, local sound effects and low dB levels, and should not have much impact
How often?
Whenever a fluid sample is drawn into a sample bottle – perhaps monthly
What is the duration of the **sound**s?
Approx 7 minutes
If directional, how will it be directed?
Non-directional

Will sound from other sources interfere with measurements by the observing system?
No
What power levels, frequencies or other characteristics would result in interference?
N/A

Will the observing system emit **light**? *No*
What will be the source and nature of the **light**?
N/A

What colour and power levels?
N/A
How often?
N/A
What is the duration of the light?
N/A
If directional, how will it be directed?
N/A
Will light from other sources interfere with measurements by the observing system?
No
What colour, intensity or other characteristics would result in interference?
N/A

Will the observing system be a source of **vibration**? *Yes*
What will be the cause and nature of the **vibration**?
The action of a gear pump to draw fluids into a sample bottle; the turning of a high pressure valve to control the bottle

What frequencies and power levels?
Not known. These are small, local vibration effects and low dB levels, and should not have much impact
How often?

Whenever a fluid sample is drawn into a bottle; perhaps monthly
What is the duration of the vibration?
Approx 7 minutes

Will vibration from other sources interfere with planned measurements?
No

What characteristics will cause vibration to interfere?
N/A

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *Unlikely*
What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *Unlikely – although almost anything installed at a vent field can act as a local "artifical reef" and attract limpits and biofouling*

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments? *Potentially*

What kinds of effects would be a problem?
Introduction of dyes may interfere with microbial analysis carried out as part of microbial incubation within isosampler

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *No*

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? ***Yes***

What kinds of effects would be a problem?
Isosampler fluid samples are used for analytical geochemistry – any agent introduced into the immediate environment would contaminate those samples

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *No*
What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Unlikely

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?

Not when deployed in hydrothermal areas; perhaps if deployed at cold seeps

What precautions are planned against damage by fishing?

None have yet been taken

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)

Firewall and ssh access.

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?

An extensive security suite is installed at our user end.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?

The system is entirely modular, and will operate as a peer-to-peer network internally, with a degree of dynamic reconfiguration in event of subsystem failure. It is connected to the network through TCP-IP protocols. We prefer to use a wireless proximity connection to the undersea Junction box, and are experimenting with a variety of copper-free connections now – to provide an additional level of electrical isolation of the system from the network.

How, where and when will the observing system be tested to establish its reliability*?

To be determined – possible MARS

Has a reliability analysis been conducted?

No

What is the probable failure rate?

Not yet established – although the mortality rate of ANY hydrothermal instrument is relatively high, given the harshness of the environment.

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?

On the seafloor

Does the sea floor need to have particular characteristics?

No – other than avoiding excessive roughness and instability

What?

What other characterstics should the site have?

Diffuse hydrothermal outflow

Will it be self-contained or is it expected to mount on or in another structure?

Self-contained

Does this structure already exist (e.g. ODP borehole)?

N/A

Will it require assembly on the seafloor, other than plugging in the cable and connector?

Installation will not require seafloor assembly; servicing might require detaching subsystems individually if we solve the wireless bus interconnect issue – making it easier to remove individual subsystems without recovering the entire unit

How big is it likely to be (height, width, depth, weight)?

1.4 m wide, 0.6 m high, 1m deep, 200 kg

How accurately will it have to be positioned (horizontal, vertical, orientation)?

Instrument frame positioned accurate to 2 m; removable sensor head accurate to cm scale.

Does it require protection from biofouling? *Possibly*

What is planned? *We are experimenting with Cu sheaths around the flow/temperature sensor; and need to establish if there will be chemical contamination as a result.*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?

Either way – but likely through an Extension Cord

How far is it likely to be from a Science Node?

Likely within 1 km of the node planned for the main Endeavour Vent Field sites.

What are the impacts of a planned interruption to the connection to the network*?

Minimal

What are the impacts of an unplanned interruption to the network connection*?

Temporary loss of command-and-control; requirement that internally-buffererd data will be retransmitted after network connection resumed

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?

Self-contained

Does this structure already exist (e.g. ODP borehole)?

N/A

Will it require assembly on the seafloor, other than plugging in the cable and connector?

Installation will not require seafloor assembly; servicing might require detaching subsystems individually if we solve the wireless bus interconnect issue – making it easier to remove individual subsystems without recovering the entire unit

How accurately will it have to be positioned (horizontal, vertical, orientation)?

Instrument frame positioned accurate to 2 m; removable sensor head accurate to cm scale. "This end up" definitely applies!

What are expected (planned) servicing requirements?

What will need to be done?

Periodic fluid sample recovery, sensor replacement for recalibration

How often?

Semi-annually to start, perhaps annually later

How long will it take?

3 hours per instrument station

Who will be responsible for the costs?

To be determined

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Geochemical fluid sample recovery must be known reasonably well at time of installation, and at time of each servicing, so appropriate experimental design can be made so as to preserve the integrity of the fluid samples

Will emergency servicing be expected if the observing system fails? *Yes*
Who will be responsible for the decision?
NEPTUNE operations in coordination with our Lab.

Who will be responsible for the cost?
To be determined

Section 12: Documentation

What documentation is available?

on the science plan – *Not yet*

on the sensors and measurement techniques - *A preliminary user's manual is now available*

on the design and specification of the observing system - *A preliminary user's manual is now available*

What information and documentation will be needed? – *A guide for interfacing to the NEPTUNE hardware interface standard and data flow standards will be required*

Theme 3 Regional Ocean/Climate Dynamics and Effects on Marine Biota

Observing System 1 Ocean Climate and Water Column Processes

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Ocean Climate and Water Column Processes

Person to contact for information:
Jay Cullen/John Dower

Purpose of the observing system:
Real-time, adaptive sampling of physical, biological and chemical properties to develop a mechanistic understanding of water column processes off the west coast of Vancouver Island.

> What questions are the observations intended to answer?
> *## cut and past from GLOBEC plus others*

Who is responsible for specification of the observing system?

Who are expected to be the initial users of data from this observing system?
Scientists
- *Academic*
- *Government (ie. DFO)*

Bamfield Marine Sciences Centre
Commercial and recreational fisherman

Is there a specific feature or site where the observing system must be located?
We propose instrumentation of the Poseidon and Barkley Canyon node lines and a node to be established near to the Rockfish Conservation Area proximate to Bamfield/Barkley Sound entrance.

What is(are) the nearest NEPTUNE Canada node(s)?
Barkley Canyon
ODP 889

How far is this from the observing system site?
Barkley node to Poseidon Deep ~35km
ODP 889 node upslope to Poseidon Shallow ~15km
ODP 889 node downslope to IODP Deep ~15km
Proposed Bamfield node is <5km from the cable

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?

A suite of COTS oceanographic sensors such as:
ADCP
Hydrophone
CTD
Nitrate sensor
Bio-optics
Gas tension devices
Video camera
(from workshop presentation:
Vertical Profiler (upper 200m)
- *CTD with Oxygen Sensor*
- *Acoustic Doppler Velocimeter*
- *Nitrate Sensor*
- *Bio-Optic Package:*
  - *Three angle backscattering*
  - *Chlo fluorometer and turbidity (with shutter)*
  - *CDOM fluorometer*
  - *AC-9-25*
  - *Hyperspectral upwelling and downwelling sensor*
  - *Sub-total*
- *pCO2 Sensor*
- *Water Sampler*
- *Bubble sounder*
- *Profiling Gas Tension Device*

Platform
- *Hydrophone*
- *Zooplankton Acoustic Profiler*

Sub-surface Mooring (1000m)
- *Upward-looking 75kHz ADCP*
- *Downward-looking 75kHz ADCP*
- *5xMicrocat CTD with Acoustic Modem*

Bottom Package
- *3x MAVS*
- *4x turbidity sensor*
- *Aquascat)*

How often will measurements be taken?
Continuous measurements for most sensors (camera at one site on demand)

Will this change according to conditions, and how?
Adaptively modulated sampling frequency to monitor rare or catastrophic events

What are the consequences of interruptions of a few hours, a day, several days, a month*?
We are not aware of any lethal hardware problems if power is interrupted.

How often will the raw measurements be transmitted to shore, and in what format?
At a rate equal to the instrument sampling frequency (as close to real time as is possible). We are not sure of each components data format.

> How many bytes of data may be expected in each transmission?
> *??*

What is required to transform the raw measurements into meaningful units?
As most gear is COTS we expect that data can be processed into units before transmission.

What format is planned for the data in meaningful units?
Standard SI units see above.

> Is there a commonly accepted standard and what is it?

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
??

> How will these corrections be determined*?
>
> How often will they need to be changed*?
>
> Who will be responsible for calibration corrections*?

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
Most instruments (CTD data, nitrate concentration, fluorometry…) can be configured to provide easily interpreted output.

Who will be responsible for monitoring the quality of the real-time data?
TBD

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
None are known at this time.

What real time NEPTUNE data not provided by this observing system will be needed for the research?

None are known at this time.

If the complete calibrated data is not available in real time, when will it be available to other users?

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
TBD
.
Is there an existing disciplinary repository for archived data?
Hydrographic data and some biological data are maintained in databases by IOS

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
???

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Control of profiling capability and sampling frequency for individual COTS instruments.

What events might require action?
Episodic events:
Upwelling, harmful algal blooms, sediment slumping, storms, oil spills

What information will be needed to make decisions to initiate an action?
Monitoring of data by investigators or by providing threshold output that will alert the investigators to an event.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
Seconds to minutes latency is likely to be acceptable

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Web based interface with appropriate security seems acceptable

What will be the amount and rate of information exchange during a controlled action?
TBD not known at present

Section 4: Communications

How often will the observing system communicate with shore?
continuous

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)

What will be the message format?

What will be the impact of a planned interruption in communication, e.g. planned network service?
Internal logging of data should be provided with the COTS…we would have to allow for more bytes transfer after a prolonged shutdown to clear data buffers.

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?

What is planned to minimize this impact?

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Not known

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?

How frequently will the instrument need to receive a time signal?

What is the best format for the time signal?

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Seconds to milli seconds

What are the consequences of an interruption in the time signal?

Section 6: Power

What voltage is the observing system expecting from the network?

What is the minimum current required?

What fraction of the time will the observing system be drawing the minimum?

What is the maximum current required (e.g. for motors, lights)?

How often will this be needed and for how long each time?

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?

What is planned to minimize this impact?

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *yes*

What will be the source and nature of the **sound**?
Profiling winch (audible range), ADCP and Zooplankton at higher frequency (100kHz)

What frequencies and power levels?

How often?
Will depend on whether the instrument is profiling or in continuous use

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system? *Potential interference from other sound emitting instruments with ADCP, hydrophones etc. if attached to same node or mooring*

What power levels, frequencies or other characteristics would result in interference?

Will the observing system emit **light**? *Likely to emit in the red 660nm eg. Fluorometers, transmissometers*

What will be the source and nature of the **light**?

What colour and power levels?

How often? *continuous*

What is the duration of the light?

If directional, how will it be directed? *Horizontal and vertical*

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**? *Profiling winch will vibrate*

What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often? *Whenever profiling*

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *no*

What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *Not likely*

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments? *Not likely*

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *Antifouling agents will likely be released*

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? *Not likely*

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *Not likely*
What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing? *yes*

What precautions are planned against damage by fishing? *Surface buoys and cooperation with CCG (hazard to shipping notice mariners) and local fisherman*

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?

How, where and when will the observing system be tested to establish its reliability*? *Some elements of the system will be tested on the VENUS array*

Has a reliability analysis been conducted? *COTS have been tested on traditional oceanographic moorings*

What is the probable failure rate?

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor? *Some gear will be deployed on the seafloor and the remainder on a taught line mooring with a profiling platform for the upper 200m*

Does the sea floor need to have particular characteristics? *no*

What?

What other characterstics should the site have?

Will it be self-contained or is it expected to mount on or in another structure? *Instruments will be mounted on the profiling platform*

Does this structure already exist (e.g. ODP borehole)?*no*

Will it require assembly on the seafloor, other than plugging in the cable and connector?*no*

How big is it likely to be (height, width, depth, weight)?
Not known need engineering input

How accurately will it have to be positioned (horizontal, vertical, orientation)? *Pressure is measured by the instrument package but the mooring location need only be known on a 10's of meter basis*

Does it require protection from biofouling? *Yep lots*
What is planned?*antifouling paints and coating as well as physical removal strategies (windshield wipes and water jets) and storing/parking the instrument package below euphotic zone*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"? *two sites will be direct to node others (3) will require extension cords*

> How far is it likely to be from a Science Node?
> *See above but >5 to <35km*

What are the impacts of a planned interruption to the connection to the network*? *See above*

What are the impacts of an unplanned interruption to the network connection*?

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure? *Mooring deployment with instruments on mooring cable or attached to profiling platform*

> Does this structure already exist (e.g. ODP borehole)? *no*
>
> Will it require assembly on the seafloor, other than plugging in the cable and connector? *No See above*

How accurately will it have to be positioned (horizontal, vertical, orientation)? *No see above*

What are expected (planned) servicing requirements?

> What will need to be done? *Periodic replacement of surface instruments in response to biofouling (months)*
>
> How often?
>
> How long will it take? *3 days onsite for 5 moorings/stations*
>
> Who will be responsible for the costs? *TBD*

How far in advance must the servicing schedule be known to have minimum impact on use of the data?

Will emergency servicing be expected if the observing system fails?

Who will be responsible for the decision?

Who will be responsible for the cost?

Section 12: Documentation

What documentation is available?

on the science plan
rough draft

on the sensors and measurement techniques
as most are COTS documentation is available

on the design and specification of the observing system
biggest unknown is the profiling winch otherwise mooring documentation exists but not specific to cabled observatory (potential information may be available from existing observatories eg. LEO-15)

What information and documentation will be needed?
Specifications for all instruments and cost versus payload capability of profiling winch system

Theme 4 Deep-sea Ecosystem Dynamics

Observing System 1 Full system, with vertical and horizontal transport, for "The Effects of Perturbations on Benthic Boundary Layer Biology"

Component: Profiling winch

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Profiling Winch
in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology".
Person to contact for information: *Don Deibel (cross reference with J. Dower).*

Purpose of the observing system: *To provide a platform on which to attach instruments that will measure temperature, conductivity, in situ fluorescence, water transmittance, and hyperbenthos (i.e. VPR) continuously, near bottom and up to 100 m above bottom in profiling mode.*

What questions are the observations intended to answer?
Basic physical and biological characteristics of the near-bottom environment.

Who is responsible for specification of the observing system?
Deibel/Group.

Who are expected to be the initial users of data from this observing system?
Deibel/Group.

Is there a specific feature or site where the observing system must be located?
We are proposing to deploy the instrument at two nodes, Barkley Canyon and Poseidon Deep. We are also proposing to locate only the fluorometer and transmissometer at an additional 3 sites but no winches.

What is(are) the nearest NEPTUNE Canada node(s)?
See above

How far is this from the observing system site?
> 100 m

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Bottom mounted electric winch for vertical profiling of sensor packages up to 100 m above bottom. It is not possible to estimate total payload at the moment, but could range between 40-100 kg in air, of sensors. Profiling velocity should be about 50 cm per sec.

How often will measurements be taken?
Routinely every 6 h.

Will this change according to conditions, and how?
Yes. If perturbation events are detected profiling could happen as frequently as hourly for several weeks.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Might miss some key events but that is always a risk. Scheduled downtime would likely be least risky during winter.

How often will the raw measurements be transmitted to shore, and in what format?
NA (not applicable). Note, however, that basic CTD, fluorometer and transmissometer data will have to be transmitted from the sensor package, probably through a conducting wire on the winch. The focus of these scenario document is, nonetheless, the winch. We will defer to the water column group and their specifications for the sensor package since our needs will mirror theirs, except perhaps for sampling frequency which we will address in terms of profile frequency.

> How many bytes of data may be expected in each transmission?
> *NA except for instrument package*

What is required to transform the raw measurements into meaningful units?
NA except for instrument package

What format is planned for the data in meaningful units?
NA except for instrument package

> Is there a commonly accepted standard and what is it?
> *NA except for instrument package*

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
NA except for instrument package

How will these corrections be determined*?
NA

How often will they need to be changed*?

NA

Who will be responsible for calibration corrections*?

NA

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)

NA

Who will be responsible for monitoring the quality of the real-time data?

NA

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?

CTD data with sensors and near bottom currents.

Some data confirming payout and recovery of wire is needed to ensure that the winch is functioning as expected. CTD may be a means to infer this.

What real time NEPTUNE data not provided by this observing system will be needed for the research?

Ditto above.

If the completed calibrated data is not available in real time, when will it be available to other users?

NA

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?

NA

Is there an existing disciplinary repository for archived data?

NA

What information should be included in meta-data from this observing system? (The NEPTUNE data policy will include requirements, but these are still under development)

NA

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Off/on, both manually and triggered by threshold values or rates of change in state variables from other sensors at the node, as well as be able to change the payout and retrieval velocity. Note that if variable speed payout drastically increases cost we can probably agree on an acceptable standard (e.g. 0.5 m/s)

What events might require action?
Rapid change in one of many environmental state variables.

What information will be needed to make decisions to initiate an action?
Values of state variables.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
< 1 minute

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Don't know.

What will be the amount and rate of information exchange during a controlled action?
Don't know.

Section 4: Communications

How often will the observing system communicate with shore?
Variable, based upon rate of change of environmental conditions.

> What is the maximum expected interval between communications?
> *Week.*
>
> The minimum?
> *< 1 min*

How much information (bytes) will each communication include?
Don't know.

If variable, what are the expected maximum and minimum?
Don't know.

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
Don't know.

What will be the message format?
Don't know.

What will be the impact of a planned interruption in communication, e.g. planned network service?
We may miss exciting, short term perturbation events.

What is planned to minimize the impact?
We request that scheduled downtime is in the winter months.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
We don't want to loose communication with the winch in 'on' condition. Must have some kind of time out automatic shutoff circuit.

What is planned to minimize this impact?

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Probably not at other sites, but winch should be controlled by sensors within the same site, perhaps by the acoustic transmission of 'off/on' information.

What is the maximum expected interval between communications?
See above.

The minimum?
Don't know.

How much information (bytes) will each communication include?
See above.

If variable, what are the expected maximum and minimum?
See above.

What will be the message format?
See above.

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
NA, though we do want the sensor package to be turned on (and off) at the right times relative to winch activity. Clock synchronization to perhaps few seconds should suffice in this respect.

How frequently will the instrument need to receive a time signal?
NA

What is the best format for the time signal?

NA

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
NA

What are the consequences of an interruption in the time signal?
NA

Section 6: Power

What voltage is the observing system expecting from the network?
Don't know. Probably 48 VDC

What is the minimum current required?
approx. 5 amps

What fraction of the time will the observing system be drawing the minimum?
99%

What is the maximum current required (e.g. for motors, lights)?
Don't know, but probably 10 amps.

How often will this be needed and for how long each time?
On each motor start up (see sampling frequency above).

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
No.

What will be the impact of a planned interruption in power, e.g. planned network service?
See above.

What is planned to minimize the impact?
See above.

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
Winch should return instruments to near bottom cradle and stand by. Otherwise the winch may not know how much wire it has paid out etc.

What is planned to minimize this impact?
See above.

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes, the winch will emit some sound but because it will likely be electric it shouldn't be too noisy*

What will be the source and nature of the **sound**?
The sound of an electric motor
What frequencies and power levels?
Unknown
How often?
During each profile (see above)
What is the duration of the **sound**s?
If wire is paid out at 0.5 m/s for 100 m, then duration will be 200 seconds.

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?
No.

What power levels, frequencies or other characteristics would result in interference?
Unknown.

Will the observing system emit **light**? *No.*
What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?
No.

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**? *Yes.*
What will be the cause and nature of the **vibration**? *Motor and drum bearings.*

What frequencies and power levels?
Don't know.

How often?
See sampling frequency above.

What is the duration of the vibration? *Same as duration of profiles.*

Will vibration from other sources interfere with planned measurements?
No.

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
No, although it may cause minor resuspension as package approaches bottom.

What will be the cause of the **turbidity**?
Bow wave from sensor package

How often and for how long?
As long as it takes the sediment to settle (depends on environment)

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?
Not for winch (but yes for associated sensor package)

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
Movement may repel some organisms. Physical structure may attract other species.

What will be the cause and nature of the effect?
Winch drum turning. Motor vibrations.

Are the planned measurement sensitive to effects on **the community** due to other experiments?
Don't understand question, but for winch itself probably No. .

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
Perhaps lubrication fluids.

What will be the source and nature of the effect?
Presumably short term and minor unless major leak occurs.

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?
No.

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**
Yes.

What will be the cause and nature of these currents or gradients?
Don't know.

What characteristics?
Don't know.

How often?
See above.

What is the duration of the electrical effects?
See above.

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
NA.

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Don't know. See node selection above.

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Had not thought about this as yet.

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Ditto above. But all university participants have standard antivirus protection.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
None.

How, where and when will the observing system be tested to establish its reliability*?
Should be field tested at Bonne Bay first, then a BC facility, perhaps VENUS or Saanich engineering node.

Has a reliability analysis been conducted?
No.

What is the probable failure rate?
Unknown.

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Either on the seafloor or on a frame 1-2 m above bottom.

Does the sea floor need to have particular characteristics? *Yes.*

What? *Sand or silt. Not rock. Relatively flat.*

What other characterstics should the site have?
None.

Will it be self-contained or is it expected to mount on or in another structure?
See above. Will need its own platform or low frame if not mounted on the I-beam structure.

Does this structure already exist (e.g. ODP borehole)? *No.*

Will it require assembly on the seafloor, other than plugging in the cable and connector?
May require some assembly on the seafloor but perhaps could be ployed as a single package..

How big is it likely to be (height, width, depth, weight)?
Cannot estimate at this time as payload is still under discussion. But payload is likely to be 100+ kilograms.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
NA

Does it require protection from biofouling? NO.
What is planned?

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
At this point, I have no idea.

How far is it likely to be from a Science Node?
More than 100 m, probably.

What are the impacts of a planned interruption to the connection to the network*?
See above.
What are the impacts of an unplanned interruption to the network connection*?
See above.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
See above.

Does this structure already exist (e.g. ODP borehole)?
See above.

Will it require assembly on the seafloor, other than plugging in the cable and connector? *See above.*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above.

What are expected (planned) servicing requirements?
What will need to be done?
Don't know.

How often? Bi-a*nnually perhaps?*

How long will it take? *ca. 1 day.*

Who will be responsible for the costs?
Don't know.

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Minimum of one month in advance.

Will emergency servicing be expected if the observing system fails? *Yes.*

Who will be responsible for the decision? *Deibel/Metaxas/Snelgrove in consultation with Chief Scientists.*

Who will be responsible for the cost? *Don't know.*

Section 12: Documentation

What documentation is available?
Don't understand the question.

on the science plan
Don't understand the question.

on the sensors and measurement techniques
Don't know.

on the design and specification of the observing system
Ditto above.

What information and documentation will be needed?
Don't understand the question.

Component : CTD

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
The Effects of Temporal and Spatial Variation in Upper Ocean Processes on Benthic Boundary Layer Biology and Material Flux

Person to contact for information: *Don Deibel*

Purpose of the observing system: *To measure temperature, conductivity, in situ fluorescence, and water transmittance continuously, near bottom and up to 100 m above bottom in profiling mode.*

What questions are the observations intended to answer?
Basic physical and biological characteristics of the near bottom environment.

Who is responsible for specification of the observing system?
Deibel/Group.

Who are expected to be the initial users of data from this observing system?
Deibel/Group.

Is there a specific feature or site where the observing system must be located?
We are proposing to deploy the instrument at two nodes, Barkley Canyon and Poseidon Deep. We are also proposing to locate only the fluorometer and transmissometer at an additional 3 sites.

What is(are) the nearest NEPTUNE Canada node(s)?
See above

How far is this from the observing system site?
Within 10 m

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Sensors

How often will measurements be taken?
Continuously, logging all sensors at a maximum rate of 2 Hz.

Will this change according to conditions, and how?
Yes. When profiling the data logging rate will be increased to 8 Hz.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Might miss some key events but that is always a risk. Scheduled downtime would likely be least risky during winter.

How often will the raw measurements be transmitted to shore, and in what format?
Data is transmitted to shore in real time in raw Seabird format (I think ASCII, but I need to check.)

> How many bytes of data may be expected in each transmission?
> *I will check with de Young.*

What is required to transform the raw measurements into meaningful units?
Dedicated software from the supplier.

What format is planned for the data in meaningful units?
Digital spreadsheet.

> Is there a commonly accepted standard and what is it?
> *I will check with de Young.*

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
All sensors will be calibrated prior to deployment. I will check with de Young as to required frequency of recalibration.

How will these corrections be determined*?
Not sure. Not my speciality. Will check with de Young.

How often will they need to be changed*?
> *See above.*

> Who will be responsible for calibration corrections*?
> *Deibel and team.*

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
Yes

Who will be responsible for monitoring the quality of the real-time data?
Deibel and team.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Near bottom current velocity and direction.

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Ditto above.

If the completed calibrated data is not available in real time, when will it be available to other users?
Within hours. QA/QC will take longer.

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Deibel and team.

Is there an existing disciplinary repository for archived data?
Yes.

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
User supplied software has comprehensive header. May want to add a line defining the node.

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Off/on, ideally to be able to change the gain on the fluorometer.

What events might require action?
Large phytodetritus pulse may require reducing gain of fluorometer.

What information will be needed to make decisions to initiate an action?
Values of state variables.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?

10's of seconds.

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Don't know, will have to de Young.

What will be the amount and rate of information exchange during a controlled action?
Don't know, will have to ask de Young.

Section 4: Communications

How often will the observing system communicate with shore?
Data will be transmitted continuously. Control communications might be daily to weekly.

What is the maximum expected interval between communications?
See above.

The minimum?

How much information (bytes) will each communication include?
Don't know.

If variable, what are the expected maximum and minimum?
Don't know.

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
Don't know but assume 100 BaseT. Will ask de Young.

What will be the message format?
Don't know.

What will be the impact of a planned interruption in communication, e.g. planned network service?
We may miss exciting, short term perturbation events.

What is planned to minimize the impact?
We request that scheduled downtime is in the winter months.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
No problem.

What is planned to minimize this impact?

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Has not been discussed.

What is the maximum expected interval between communications?
See above.

The minimum?
Don't know.

How much information (bytes) will each communication include?
See above.

If variable, what are the expected maximum and minimum?
See above.

What will be the message format?
See above.

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
10-100 millisec

How frequently will the instrument need to receive a time signal?
I am guessing that daily would be sufficient, but it is only a guess.

What is the best format for the time signal?
Don't know, ask de Young.

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Milli.

What are the consequences of an interruption in the time signal?
We may be unable to synch data with other instruments, rending the data of limited value for interpretation.

Section 6: Power

What voltage is the observing system expecting from the network?
12-15 V.

What is the minimum current required?
Will have to check.

What fraction of the time will the observing system be drawing the minimum?
Don't know.

What is the maximum current required (e.g. for motors, lights)?
Will have to check but am guessing no more than 2 amps.

How often will this be needed and for how long each time?
Continuously.

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
No.

What will be the impact of a planned interruption in power, e.g. planned network service?
See above.

What is planned to minimize the impact?
See above.

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
See above.

What is planned to minimize this impact?
See above.

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes.*
What will be the source and nature of the **sound**? *Small pump for conductivity cell.*

What frequencies and power levels?
Don't know.

How often? *Continuously.*

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?
No.

What power levels, frequencies or other characteristics would result in interference?
Unknown.

Will the observing system emit **light**? *Yes.*
What will be the source and nature of the **light**? *Fluorometer strobe in blue range and continuous transmissometer in the red range.*

What colour and power levels?
See above for colour. Not sure about the power levels, but they emit very low intensities of light.

How often?
Continuously.

What is the duration of the light?
See above.

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?
Yes.

What colour, intensity or other characteristics would result in interference?
Blue and red, but intensities are difficult to estimate.

Will the observing system be a source of **vibration**? *No.*
What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?
No.

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
No.

What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?
Yes. Any level above ambient.

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
The low light intensities are not expected to affect organism behaviour.

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments?
Don't understand question.

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
No.

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?
No, except local heating would not be a good idea.

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**
Don't know, will have to ask Seabird.

What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
I think no.

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Don't know. See node selection above.

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Had not thought about this as yet.

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Ditto above.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
None.

How, where and when will the observing system be tested to establish its reliability*?
Field tested at the Bonne Bay Cabled Observatory, before being shipped to Victoria for deployment.

Has a reliability analysis been conducted?
No.

What is the probable failure rate?
Unknown. Seabird must have data on this.

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
This is still under discussion. Our first choice would be mounted on a bottom-tethered ROV, with capability to rise up to 100 m above bottom. Our second choice will be mounted on a metal framework near bottom, and attached to a profiling winch which will enable video profiles to be taken between 1 m and 100 m above bottom.

Does the sea floor need to have particular characteristics? *Yes.*

What? *Sand or silt. Not rock. Relatively flat.*

What other characterstics should the site have?
None.

Will it be self-contained or is it expected to mount on or in another structure?
It will require mounting to a larger frame or vehicle. See above.

Does this structure already exist (e.g. ODP borehole)? *No.*

Will it require assembly on the seafloor, other than plugging in the cable and connector?
The instrument will not need assembly on the seafloor. It may need mounted on the seafloor, or not, I don't know. Likely it will require only plugging the instrument into the node box.

How big is it likely to be (height, width, depth, weight)?
Approximately 1.5 m high, 0.3 m wide, 0.3 m deep and ca. 20 kg in air.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Should be maintained close to vertical.

Does it require protection from biofouling?
What is planned?
Yes. Satlantic has many solutions in hand. It has two optical surfaces, and they both must be protected from biofouling. Talk to Scott from SatLantic.

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
At this point, I have no idea. We wish it to be co-located with the video plankton recorder, and perhaps intake for our large volume pump.

How far is it likely to be from a Science Node?
No more than 20 m, probably.

What are the impacts of a planned interruption to the connection to the network*?
See above.
What are the impacts of an unplanned interruption to the network connection*?
See above.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
See above.

Does this structure already exist (e.g. ODP borehole)?
See above.

Will it require assembly on the seafloor, other than plugging in the cable and connector? *See above.*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above.

What are expected (planned) servicing requirements?

What will need to be done?
Clean optical surfaces, check calibration factors.

How often? *Annually should be sufficient.*

How long will it take? *ca. 1 day.*

Who will be responsible for the costs?
Has not been discussed. First guess might be that since this must be a basic instrument of importance to almost all groups in NEPTUNE, it should be a network expense.

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Minimum of one month in advance.

Will emergency servicing be expected if the observing system fails? *Yes.*
Who will be responsible for the decision? *Deibel/Metaxas/Snelgrove in consultation with Chief Scientists.*

Who will be responsible for the cost? *Network.*

Section 12: Documentation

What documentation is available?
Don't understand the question.

on the science plan
Don't understand the question.

on the sensors and measurment techniques
Manual from Seabird.

on the design and specification of the observing system
Ditto above.

What information and documentation will be needed?
Don't understand the question.

Component : Current meters

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Current meters (upward looking ADCP, ADV) in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology".

Person to contact for information: *Metaxas/Hay*

Purpose of the observing system: *To measure velocity and turbulence in the benthic boundary layer (up to 100 mab)*

What questions are the observations intended to answer?
How benthic biota change as a function of time and height above bottom, in response to physical, chemical and biological environmental perturbations.

Who is responsible for specification of the observing system?
Metaxas/Hay

Who are expected to be the initial users of data from this observing system?
Metxas/Hay

Is there a specific feature or site where the observing system must be located?
We are proposing to deploy an ADCP at four nodes, Barkley Canyon, Poseidon Deep, Poseidon Shallow, IODP Deep and IODP 1027, and two ADVs at each of Barkley Canyon and, Poseidon Deep.

What is(are) the nearest NEPTUNE Canada node(s)?
See above

How far is this from the observing system site?
Within 100 m

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Sensors

How often will measurements be taken?
Continuously

Will this change according to conditions, and how?

What are the consequences of interruptions of a few hours, a day, several days, a month*?

Might miss some key events but that is always a risk. Scheduled downtime would likely be least risky during winter.

How often will the raw measurements be transmitted to shore, and in what format?
For both types of instruments (ADCP and ADV), the data can be transmitted real-time in binary form. The ADV can also be output in ASCII format, but this limits the sampling rate.

How many bytes of data may be expected in each transmission?
The size of the files depends on the sampling rate used by the instruments. The following is our most greedy scenario

ADVO 22 bytes/sample (no compass installed)
28 bytes/sample (with compass)

ADCP ensembles over 128 depth bins, 3220 bytes/ensemble

Per hour, the total data for the ADCP at 1 ensemble every 15 seconds
*(4*3220*60) = 772800 bytes (754 kB)*
for the ADVO at 4 Hz
*28*4*60*60 = 403200 bytes (394 kB)*

What is required to transform the raw measurements into meaningful units?
The binary data would need to be decoded to gain meaningful data. This can be done real-time via existing Matlab code, or via other programming language.

What format is planned for the data in meaningful units?
Velocity data in m/s

Is there a commonly accepted standard and what is it?

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
N/A

How will these corrections be determined*?
N/A

How often will they need to be changed*?
N/A

Who will be responsible for calibration corrections*?
Hay/Metaxas

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
Near bottom velocities and water column profile velocities (provided we can run our code to convert binary to ascii realtime –via a crontab, or some other form of scheduling)

Who will be responsible for monitoring the quality of the real-time data?
Hay/Metaxas

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Surface and bottom CTD

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Surface and bottom CTD

If the completed calibrated data is not available in real time, when will it be available to other users?
Available real-time

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Hay/Metaxas

Is there an existing disciplinary repository for archived data?

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Time/date, location, depth

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
On/off, increased frequency

What events might require action?
Perturbations such as slumping or increased sedimentation or change in velocity regime

What information will be needed to make decisions to initiate an action?
See above

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
Minutes

What is the expected format of commands (e.g. serial sequences, web-based frames)?
ASCII commands sent via a serial port. For example, to change the number of bins we collect via the ADCP, the ADCP must be sent an 'end' character, and then 'wn=nn', where nn is the new number of bins, then issued 'cs' to start pinging again. A hyperterm type application to execute this type of communication would work fine.

What will be the amount and rate of information exchange during a controlled action?
This depends on the number of sampling parameters which need to be changed, but the total number of bytes sent would be quite small.

Section 4: Communications

How often will the observing system communicate with shore?

What is the maximum expected interval between communications?
1 Day

The minimum?
0.25 sec for 4 Hz sampling from the ADVO – the data will be automatically sent out along the serial port

How much information (bytes) will each communication include?
28 bytes per transmission from the ADVO, 3220 bytes per ensemble for the ADCP

If variable, what are the expected maximum and minimum?

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
RS422 (due to the distance between the instruments and the nodes)

What will be the message format?
Instrument control and setup will be ASCII commands, but the data will be in a binary format.

What will be the impact of a planned interruption in communication, e.g. planned network service?
None

What is planned to minimize the impact?
Nothing yet

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Missing some important pertubation

What is planned to minimize this impact?

Nothing yet

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Not sure, but probably not for now.

What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
Milli

How frequently will the instrument need to receive a time signal?
Once a day

What is the best format for the time signal?
The instruments will need to stop collecting and an ASCII command issued along the serial port to update the clock. For the ADVO this is a +++, then 'time hh:mm:ss' For the ADCP an 'end' then 'ttccyy/mm/dd, hh:mm:ss'

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
milli

What are the consequences of an interruption in the time signal?
May miss an important perturbation

Section 6: Power

What voltage is the observing system expecting from the network?
ADVO 12-24 V
ADCP 20-60 V

What is the minimum current required?
ADVO 3-5 W (0.125-2.2 amp)
ADCP

What fraction of the time will the observing system be drawing the minimum?
Always

What is the maximum current required (e.g. for motors, lights)?

How often will this be needed and for how long each time?
While instruments are sampling, they draw max current

Is there any intermediate level of current requirement?

If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?
Little impact, we can work around that.

What is planned to minimize the impact?
No plans yet.

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
Miss an important pertubation event.

What is planned to minimize this impact?
No plans yet.

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes*
What will be the source and nature of the **sound**? *Transducers*

What frequencies and power levels?
ADVO 5MHz
ADCP 600 kHz

How often?
ADVO 4Hz
ADCP 60 pings per ensemble

What is the duration of the **sound**s?
< 10 ms, but repeated

If directional, how will it be directed?
ADVO –downward
ADCP -- upward

Will sound from other sources interfere with measurements by the observing system?
Not likely

What power levels, frequencies or other characteristics would result in interference?

Will the observing system emit **light**? *No*

What will be the source and nature of the **light**?

What colour and power levels?

How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?

What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**? *No*

What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *No*

What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *Yes, it may act as an attractor of fish and zooplankton*

What will be the cause and nature of the effect? *The presence of structure*

Are the planned measurement sensitive to effects on **the community** due to other experiments? *No*

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *No*

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? *No*

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**

What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?

What characteristics will cause interference?

Are there any **other potential sources of interference**?
The metal frames will affect the local magnetic field. This will be accounted for with compass calibration we will execute. Other nearby metal frames may affect the compass reading.

Other frames might create turbulent flow, would like the advo to be clear from any other instrumentation frame.

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Don't know. I assume in Barkley Canyon…

What precautions are planned against damage by fishing?
None yet

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.) *Don't know yet.*

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Don't know yet aside from standard anti-virus protection.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
None yet

How, where and when will the observing system be tested to establish its reliability*?
Although the equipment is off the shelf, Bonne Bay and Victoria, assuming there will be a NEPTUNE test bed.

Has a reliability analysis been conducted?
COTS

What is the probable failure rate?
Don't know

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
On the seafloor

Does the sea floor need to have particular characteristics? *No.*

What?

What other characterstics should the site have?

Will it be self-contained or is it expected to mount on or in another structure?
Most likely on a frame

Does this structure already exist (e.g. ODP borehole)?
No.

Will it require assembly on the seafloor, other than plugging in the cable and connector? *Probably not*.

How big is it likely to be (height, width, depth, weight)?

How accurately will it have to be positioned (horizontal, vertical, orientation)?

Does it require protection from biofouling? *No*
What is planned?

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
Do not know yet, site dependant.

How far is it likely to be from a Science Node?
No more than 100 m, probably.

What are the impacts of a planned interruption to the connection to the network*?
See above

What are the impacts of an unplanned interruption to the network connection*?
See above

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
See above

Does this structure already exist (e.g. ODP borehole)?
. *See above*

Will it require assembly on the seafloor, other than plugging in the cable and connector?. *See above*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above

What are expected (planned) servicing requirements?

What will need to be done?

How often?

How long will it take?

Who will be responsible for the costs?

How far in advance must the servicing schedule be known to have minimum impact on use of the data? *6 months*

Will emergency servicing be expected if the observing system fails? *Yes.*

Who will be responsible for the decision? *Metaxas/Hay*

Who will be responsible for the cost? *Shared by the primary users.*

Section 12: Documentation

What documentation is available?

on the science plan

on the sensors and measurement techniques
COTS

on the design and specification of the observing system
COTS

What information and documentation will be needed?

Component : Video Plankton Imager

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Video Plankton Imager (VPR) in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology".

Person to contact for information: *Don Deibel*

Purpose of the observing system: *To make quantitative estimation of the species composition, abundance, body size and reproductive condition of benthopelagic zooplankton, larvae and benthic infauna using a video plankton recorder (VPR).*

What questions are the observations intended to answer?
How the above characteristics of benthic biota change as a function of time and height above bottom, in response to physical, chemical and biological environmental perturbations.

Who is responsible for specification of the observing system?
Deibel/Metaxas/Snelgrove

Who are expected to be the initial users of data from this observing system?
Deibel/Metaxas/Snelgrove

Is there a specific feature or site where the observing system must be located?
We are proposing to deploy the instrument at two nodes, Barkley Canyon and Poseidon Deep.

What is(are) the nearest NEPTUNE Canada node(s)?
See above

How far is this from the observing system site?
We are concerned about artifacts in benthic fauna that will certainly be introduced by any and all permanent node structures on and above the bottom. Therefore, ideally we would like to be able to make measurements with the VPR system (and associated instruments in the package, e.g. CTD, etc.) perhaps several hundreds of meters away from the node junction box.

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Video of organisms ranging in size from 0.1 to about 10 mm.

How often will measurements be taken?
Measurement frequency will be variable, depending upon the experiment. We will make intensive measurements (perhaps 2-3 h of video per 24 h period) in response to events. In the absence of events, we will make measurements for four 30 minute intervals in each 24 h period.

Will this change according to conditions, and how?
See above.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Might miss some key events but that is always a risk. Scheduled downtime would likely be least risky during winter.

How often will the raw measurements be transmitted to shore, and in what format?
Data is transmitted to shore in real time following wavelet compression.

> How many bytes of data may be expected in each transmission?
> *100 mega-bits per second for 30 minutes.*

What is required to transform the raw measurements into meaningful units?
Dedicated software from the supplier decodes the wavelet files and displays them in user-defined image format, such as jpeg, etc.

What format is planned for the data in meaningful units?
Grabbed frames containing targets of interest.

> Is there a commonly accepted standard and what is it?
> *There is no standard. jpeg is common for the images.*

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
Field of view (i.e. volume of seawater sampled per frame) is carefully calibrated for each magnification setting and is stable.

How will these corrections be determined*?
In situ images of objects of known size in three dimensions.

How often will they need to be changed*?
> *Not more frequently than annually.*

Who will be responsible for calibration corrections*?
Deibel and team.

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
We should be able to set up the system so that it captures raw frames containing Regions of Interest (e.g. critters plus objects of similar size). These would be ROIs per unit time, per unit sampling volume. The sampling volume will not change very often.

Who will be responsible for monitoring the quality of the real-time data?
This question and those to follow concerning QA/QC, routine instrument maintenance and instrument repair raises an important operational question for the NEPTUNE program. NEPTUNE is a national facility. It is envisioned that groups of scientists will come and go over the years, with separate funding for specific scientific projects of limited term (i.e. 3-5 years of funding for a typical project, for example). The present activity we are undertaking is to request money from a pool to purchase instruments generic to our disciplinary field of study. There is no money in this pool, as we understand it, to hire technical staff to perform routine QA/QC tasks, nor for instrument maintenance and repair. Furthermore, as the instruments belong to the network, and not to any individual investigator, and the data are to be released into the public domain via the internet, it is difficult to rationalize that the research grant of any particular investigator could or should be responsible for maintenance and repair. Returning to the QA/QC question, NEPTUNE would surely want continuity over the long term in this activity. As research money will be project based, there will not be continuity in the individual(s) who could or should take responsibility for QA/QC. In short, we believe that NEPTUNE should consider setting up a technical group from the central budget for QA/QC and instrument maintenance and repair. Otherwise, these functions will occur, or not, as the budgetary winds blow for individual science projects.
Deibel/Snelgrove/ Metaxas if funds are available.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Within the benthic boundary layer, CTD, fluorescence, transmittance, bottom current velocity and direction, etc. Surface phytoplankton concentration, vertical flux of organic material. Upper and mid-water column data (currents, CTD, fluorescence).

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Surface and bottom CTD, fluorescence, transmittance, bottom currents etc. The availability of such data in real or near-real time would allow us to adapt sampling and perhaps move to higher frequency sampling during interesting events.

If the completed calibrated data is not available in real time, when will it be available to other users?

Raw images will be available in real time. Images calibrated to field of view will be available monthly, but this calibration will not change very often and approximations can be made in the interim. Identified targets will be available depending upon researcher's science agenda.

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Deibel/Snelgrove/Metaxas, depending upon availability of funds (see above).

Is there an existing disciplinary repository for archived data?
No

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Time/date, frame number, camera serial number, frame rate, location, depth (height above bottom), magnification. Note that the existing VPR system links CTD data directly to the individual ROIs and an ~0.01 second time synchronization is used.

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Off/on, change magnification (i.e. zoom lens), frame rate (i.e. 15 fps, 30 fps, 60 fps, etc.). 60 frames per second would be the maximum exposure rate.

What events might require action?
Change in state of environmental forcing functions, such as bottom current velocity, sediment slumps, phytodetritus sinking pulses, vent outflow, etc.

What information will be needed to make decisions to initiate an action?
Near real time information concerning the above environmental state variables.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
To change magnification of a camera lens, latency could be up to a few seconds.

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Don't know, will have to ask camera system supplier (SeaScan, Falmouth, MA).

What will be the amount and rate of information exchange during a controlled action?
Don't know, will have to ask camera system supplier. (SeaScan, Falmouth, MA).

Section 4: Communications

How often will the observing system communicate with shore?
Perhaps 4-6 times per day for 30 min at a time.

What is the maximum expected interval between communications?
24 h

The minimum?
1 h for mmost operations, but seconds if we are trying to focus the camera

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?
180,000 megabits to 800,000 megabits (at 100 megabits per sec)

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
Don't know, will have to ask Scott at SatLantic.

What will be the message format?
Ditto ask Scott at SatLantic

What will be the impact of a planned interruption in communication, e.g. planned network service?
We may miss exciting, short term perturbation events.

What is planned to minimize the impact?
We request that scheduled downtime is in the winter months.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
No problem, except for power draw if camera and strobe light remain in the 'power on' configuration.

What is planned to minimize this impact?
We could investigate with the supplier to configure the software to some maximum power on time interval, such as 4 h. This could then power down the instrument if communication were broken.

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Never. Having said that it would be awfully cool to have the VPR trigger the plankton pump to sample more frequently if high concentrations of ROI are detected.

What is the maximum expected interval between communications?
One week.

The minimum?
One minute, though seconds for focussing.

How much information (bytes) will each communication include?
See above.

If variable, what are the expected maximum and minimum?
See above.

What will be the message format?
See above.

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
10-100 millisec

How frequently will the instrument need to receive a time signal?
At each power up.

What is the best format for the time signal?
Don't know, ask Scott at SatLantic.

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Milli.

What are the consequences of an interruption in the time signal?
We may be unable to synch data with other instruments, rending the data of limited value for interpretation.

Section 6: Power

What voltage is the observing system expecting from the network?
Will have to check with Seascan.

What is the minimum current required?
Will have to check with Seascan.

What fraction of the time will the observing system be drawing the minimum?
5%

What is the maximum current required (e.g. for motors, lights)?
Will have to check with Seascan.

How often will this be needed and for how long each time?
See above on sampling frequency and duration. When the camera is on, the strobe light will be on. There will be no case of one without the other.

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
No.

What will be the impact of a planned interruption in power, e.g. planned network service?
See above.

What is planned to minimize the impact?
See above.

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
See above.

What is planned to minimize this impact?
See above.

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *No.*
What will be the source and nature of the **sound**?

What frequencies and power levels?

How often?

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?
Sound from other sources will not interfere with the instrument but it may interfere with the behaviour of the organisms being observed by the instrument.

What power levels, frequencies or other characteristics would result in interference?
Unknown. But it is important to talk to SeaScan about use of multifiber and the effect that may have on interference with video data transfer. This may render the SeaScan unit unusable for Neptune though one would hope there is some other solution.

Will the observing system emit **light**? *Yes.*
What will be the source and nature of the **light**? *Small strobe light at 10-60 Hz.*

What colour and power levels?
Visible spectrum, will have to check on power level. We may wish to reduce waveband to red end of the visible spectrum to reduce attraction factor.

How often?
See above on sampling frequency.

What is the duration of the light?
Same as frequency and duration of sample taking, above.

If directional, how will it be directed?
The beam is uni-directional but it may be aimed in any direction at any given time.

Will light from other sources interfere with measurements by the observing system?
Yes.

What colour, intensity or other characteristics would result in interference?
Any frequency in the visible band and intensities > 0.1 lux.

Will the observing system be a source of **vibration**? *No.*
What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?
Yes.

What characteristics will cause vibration to interfere?
Vibration could affect both camera system performance (i.e. image clarity) as well as organism behaviour.

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
No.
What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?
Yes. Any level above ambient.

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
The strobe light may attract organisms. Steps to minimize include using red light and minimizing data gathering time.

What will be the cause and nature of the effect?
See above.

Are the planned measurement sensitive to effects on **the community** due to other experiments?
Yes they are - we are measuring plankton abundance and behaviour, so any activities that may result in disturbance of plankton populations (e.e. increased turbidity, movement of equipment, removal or introduction of fauna

What kinds of effects would be a problem?

See above
Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
No (this would only be an issue at a very small scale near the antifoulants or if a large amount of contaminants were released).
What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?
No. But altered water chemistry may affect behaviour of target organisms.

What kinds of effects would be a problem?
Anything that would alter natural organism behaviour, distribution or abundance.

Will the observing system be a source of **electrical currents or gradients of electrical potential?**
Don't know, will have to ask Seascan.

What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
I think not, but again, organism behaviour may be compromised.

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Don't know. See node selection above.

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Had not thought about this as yet. Do you mean our individual computers? These are protected by the individual universities

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Ditto above. But again our individual computers all have up to date anti-virus software.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
None.

How, where and when will the observing system be tested to establish its reliability*?
We are already operating two VPR's, one in vertical cast mode and one in moored mode. However, we have not operated at the depths planned for NEPTUNE nor along with such a large array of other, nearby instruments. The newly purchased VPR's will be field tested at the Bonne Bay Cabled Observatory, before being shipped to Victoria for deployment.

Has a reliability analysis been conducted?
No.

What is the probable failure rate?
Unknown. The strobe lights will have a finite lifetime, which will have to be gotten from Seascan. My recollection is ca. 800 h at 60 Hz. This would allow for > 2 h per day of continuous data gathering per year bulb change.

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
This is still under discussion. Our first choice would be mounted on a bottom-tethered ROV, with capability to rise up to 100 m above bottom. Our second choice will be mounted on a metal framework near bottom, and attached to a profiling winch which will enable video profiles to be taken between 1 m and 100 m above bottom. ROV piloting is also an issue. Ideally, we would want to program the ROV to follow the same path in 3-D space per profile. Of course we would also want manual override capability as well as capability to re-program to a different 3-D path. An ROV that requires a pilot for every vertical profile would be of limited utility.

Does the sea floor need to have particular characteristics? *Yes.*

What? *Sand or silt. Not rock. Relatively flat, no adjacent topographic features.*

What other characterstics should the site have?
None.

Will it be self-contained or is it expected to mount on or in another structure?
It will require mounting to a larger frame or vehicle. See above.

Does this structure already exist (e.g. ODP borehole)? *No.*

Will it require assembly on the seafloor, other than plugging in the cable and connector?
The instrument will not need assembly on the seafloor. It may need mounting on the seafloor, or not, I don't know. Likely it will require only plugging the instrument into the node box.

How big is it likely to be (height, width, depth, weight)?
Approximately 1.5 m high, 0.5 m wide, 0.5 m deep and ca. 20 kg in air.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Ideally it should always face into the local flow. For infaunal imaging we imagine that it will need to be rigidly fixed in a cradle so as to image organisms being pumped through a tube, while transiting the field of view.

Does it require protection from biofouling?
What is planned?
Yes. Satlantic has many solutions in hand. It has two optical surfaces, and they both must be protected from biofouling. Talk to Scott from SatLantic.

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
At this point, I have no idea. Scott at SatLantic has hooked one of these instruments up at the Bonne Bay Cabled Observatory for us. He knows the technical details of how best to hook the instrument to the node. We need to have a sit-down discussion with the NEPTUNE engineers, Scott and the scientists, either at the Halifax meeting or before, via telephone, etc.

How far is it likely to be from a Science Node?
More than 100 m, probably.

What are the impacts of a planned interruption to the connection to the network*?
See above.
What are the impacts of an unplanned interruption to the network connection*?
See above.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
See above.

Does this structure already exist (e.g. ODP borehole)?
See above.

Will it require assembly on the seafloor, other than plugging in the cable and connector? *See above.*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above.

What are expected (planned) servicing requirements?

What will need to be done?
Clean optical surfaces, check internal electronics, replace strobe bulbs.

How often? *Annually should be sufficient.*

How long will it take? *ca. 1 hour in situ, but it may require recovering the instrumentand cleaning on board ship if ROPOS etc. can't do the job.*

Who will be responsible for the costs?
See comments above regarding network sustainability.

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Minimum of one month in advance.

Will emergency servicing be expected if the observing system fails? *Yes.*
Who will be responsible for the decision? *Deibel/Metaxas/Snelgrove in consultation with suppliers and NEPTUNE engineers.*

Who will be responsible for the cost? *See comments above regarding network sustainability.*

Section 12: Documentation

What documentation is available?
Don't understand the question. SeaScan has a msierable users manual available that does supply some schematics and specifications, though as a users manual it stinks.

on the science plan
Don't understand the question.

on the sensors and measurment techniques
Manual from Seascan and published papers using previous models of this instrument.

on the design and specification of the observing system
Ditto above.

What information and documentation will be needed?
A much better users manual for new users will be needed.

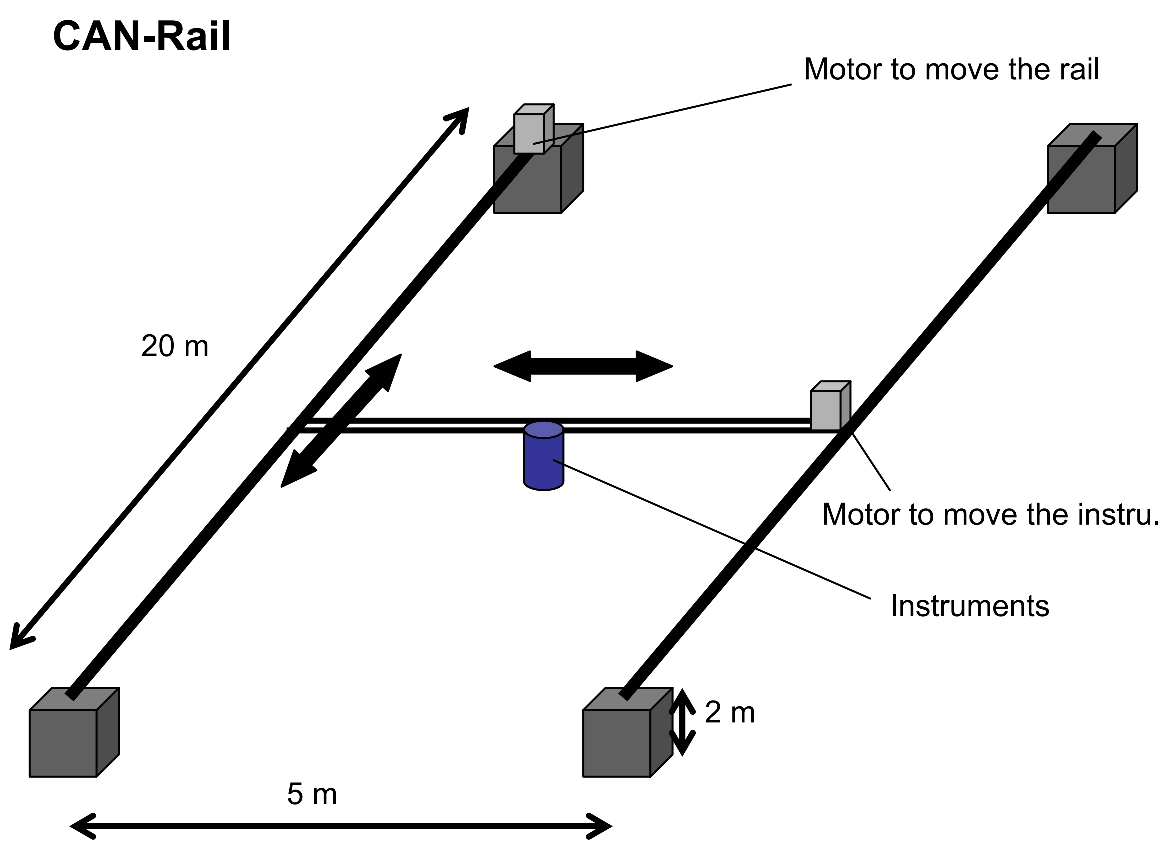
Component : CanRail traversing carriage

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Can-Rail in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology"

Person to contact for information: *Philippe Archambault*

Purpose of the observing system: *Carrying instruments over an area of 20 m X 5 m (see drawing)*



What questions are the observations intended to answer?

Provide a precise location above (cm scale) and area over the long-term. It will need to return to the same location regularly

Who is responsible for specification of the observing system?
Archambault

Who are expected to be the initial users of data from this observing system?
Deep sea benthic ecosystem team (Archambault, Desrosiers, McKindsey, Metaxas Snelgrove, Tunnicliffe)

Is there a specific feature or site where the observing system must be located?
2 sites- Barkley Canyon and Poseidon Deep

What is(are) the nearest NEPTUNE Canada node(s)?
See above

How far is this from the observing system site?
Can be within 100 m of main node depending on footprint of disturbance from node deployment.

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
No measurement except keeping track of position in x,y space. It will carry, specific instruments (e.g. camera system, SedView) that will make measurements.

How often will measurements be taken?
Variable and dependent on experiment. But perhaps a few hours of surveying a grid on a given day. Typically this might be done once every few days or once a week.

Will this change according to conditions, and how?
Yes, during flux events might want to do measurements up to 4 times per day.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Might miss some key events but that is always a risk.

How often will the raw measurements be transmitted to shore, and in what format?
Instrument attached will transmit information not the CAN-Rail but we need to send coordinates to the small motor, so they can bring the instruments above a specific location

> How many bytes of data may be expected in each transmission?
> *500 k, I'm guessing*

What is required to transform the raw measurements into meaningful units?
?

What format is planned for the data in meaningful units?
X, Y Position in Centimetre units and time stamp

> Is there a commonly accepted standard and what is it?
> *Centimetre or meter*

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
None, although X,Y positioning could have some drift and some mechanism to check that periodically would be desirable. This could be achieved by simply placing two permanent markers of known position within the observation grid, visiting them periodically with the camera, and matching known position from calculated X,Y position..

How will these corrections be determined*?
NA

How often will they need to be changed*?
Depends on drift of stepper motors but expected to be infrequent (weekly?)

Who will be responsible for calibration corrections*?
NA

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.) *See instruments specification. The CAN-Rail is just something to move the instruments*

Who will be responsible for monitoring the quality of the real-time data?
The responsibity of individual instruments attached to the CAN-Rail will fall to the PI utilizing the instrument but the X,Y issue will be Archambault and other PIs utilizing instruments.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Related to the instruments attached

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Related to the instruments attached

If the complete calibrated data is not available in real time, when will it be available to other users?
Related to the instruments attached

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Related to the instruments attached

.

Is there an existing disciplinary repository for archived data?
Related to the instruments attached, but generally not.

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Related to the instruments attached

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
To be turn on/off and to move to the coordinates desired above the $100m^2$ *bottom area that it traverses.*

What events might require action?
Will depend of the specific instrument used, but evidence of increased phytodetritus, for example, might result in increased numbers of surveys and thus increased stepper motor activity.

What information will be needed to make decisions to initiate an action?
Will depend of the specific instrument used.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
5 sec. before starting to move to the position.

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Serial sequences

What will be the amount and rate of information exchange during a controlled action?
Not more than 500 k to send the coordinates, I'm guessing.

Section 4: Communications

How often will the observing system communicate with shore?
Will depend of the specific instrument used, but the traverse system will need to communicate with shore every time it moves.

> What is the maximum expected interval between communications?
> *Perhaps a week?*
>
> The minimum?
> *Few minutes*

How much information (bytes) will each communication include? *Not more than 500 k*

If variable, what are the expected maximum and minimum?
NA
What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
?

What will be the message format?
?

What will be the impact of a planned interruption in communication, e.g. planned network service?
Possibility of missing an event.
What is planned to minimize the impact?
Nothing is planned

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Possibility of missing an event. Will also need to program the system to return to a "home" position during interruptions so that it does not lose track of its position.

What is planned to minimize this impact?
Nothing is planned

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
NA
What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?
NA
If variable, what are the expected maximum and minimum?
NA
What will be the message format?
NA

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
None when in position. But second accuracy would be helpful in making sure the instruments take measurements where we think they are taking them.

How frequently will the instrument need to receive a time signal?
None, once it is in position

What is the best format for the time signal?

Hours, min, sec,

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Seconds is sufficient

What are the consequences of an interruption in the time signal?
None

Section 6: Power

What voltage is the observing system expecting from the network?
Enough to move instruments (around 100 Kg) attach to rails with two motors

What is the minimum current required?
This will depends of the motor used.

What fraction of the time will the observing system be drawing the minimum?
This will depends of the motor used.

What is the maximum current required (e.g. for motors, lights)?
This will depends of the motor used.

How often will this be needed and for how long each time?
Few minutes during the time that the position is reach.

Is there any intermediate level of current requirement? *no*
If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?
The motors will not move and a possibility of missing an event. Will require some programming to ensure unit returns to "home" once power is restored.

What is planned to minimize the impact?
Nothing

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply? *The motors will not move and a possibility of missing an event.*

What is planned to minimize this impact? *Nothing*

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes*
What will be the source and nature of the **sound**? *Two stepper motors to move an instrument package along and across the rail.*

What frequencies and power levels? *Unknown*

How often? *Unknown*

What is the duration of the **sound**s? *Few minutes each time*

If directional, how will it be directed? *NA*

Will sound from other sources interfere with measurements by the observing system? *No*

What power levels, frequencies or other characteristics would result in interference? *Unknow*

Will the observing system emit **light**? *No*
What will be the source and nature of the **light**? *NA*

What colour and power levels? *NA*

How often? *NA*

What is the duration of the light? *NA*

If directional, how will it be directed? *NA*

Will light from other sources interfere with measurements by the observing system? *NA*

What colour, intensity or other characteristics would result in interference? *NA*

Will the observing system be a source of **vibration**? *Yes*
What will be the cause and nature of the **vibration**? *Motor in action*.

What frequencies and power levels? *Unkown*

How often? *Unknown*

What is the duration of the vibration? Only *during the use of motor to reach the position.*

Will vibration from other sources interfere with planned measurements?
no

What characteristics will cause vibration to interfere?
NA

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *No*

What will be the cause of the **turbidity**?
NA

How often and for how long?
NA

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem? *This rail system will be used to study sediments and bioturbation, so although the functioning of the traverse system will be unaffected by turbidity the measurements it helps to collect could become meaningless.*

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *Yes,*

What will be the cause and nature of the effect? *Any physical structure will attract mobile organisms and eventually fouling organisms will also become established.*

Are the planned measurement sensitive to effects on **the community** due to other experiments?

What kinds of effects would be a problem?
The attraction but we need to deal with it

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *NO*

What will be the source and nature of the effect?
NA

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? *Only if large amounts of contaminants were released*

What kinds of effects would be a problem? *NA*

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *Probably*

What will be the cause and nature of these currents or gradients?
The stepping motors will be electric

What characteristics?
Unknown

How often?
Depends on sampling frequency but a few hours a day at most.

What is the duration of the electrical effects?
Unknown

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
No

What characteristics will cause interference?
NA

Are there any **other potential sources of interference**?
No

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Unknown, but probably more an issue in Barkley Canyon (see position of the site)

What precautions are planned against damage by fishing?
None, but we expect that this is a general issue for the Barkley site in particular.

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Unknown

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Unknown, but individual user universities do keep computers updated with Antivirus software.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
Unknown

How, where and when will the observing system be tested to establish its reliability*?
Unknown. Ideally we might wish to test it in Bonne Bay but because of the physical structures involved (i.e. railbed) it might only be possible to test the stepper motors prior to NEPTUNE deployment.

Has a reliability analysis been conducted?
No, given that system does not exist in an off-the-shelf format (though stepper motors for this sort of application do exist).

What is the probable failure rate?
Unknown

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Sit on the seafloor (see picture at page 1)

Does the sea floor need to have particular characteristics?
Soft sediment, though a similar approach could also conceivably be used at a vent site.
What?

What other characterstics should the site have?
Relatively flat area with no adjacent topographic highs etc.

Will it be self-contained or is it expected to mount on or in another structure?
This is the structure that will support many instruments

> Does this structure already exist (e.g. ODP borehole)?
> *No but this rail design is similar to the large crane that is used to unload containers from a ship to a pier. Stepper motor systems exist for laboratory movement of sensors also.*
>
> Will it require assembly on the seafloor, other than plugging in the cable and connector? *yes*

How big is it likely to be (height, width, depth, weight)?
20 m X 5 m X 2 m. Several instruments will be attached to the rail. We think the instruments will weight around 100 kg.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
The position is important in relation to the habitat (see above).

Does it require protection from biofouling? *yes*
What is planned? *paint*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
Unknown

How far is it likely to be from a Science Node?

Unknown, but can be as close as 100 m if that works for other groups.

What are the impacts of a planned interruption to the connection to the network*?
See above.

What are the impacts of an unplanned interruption to the network connection*?
See above.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
Self contained.

Does this structure already exist (e.g. ODP borehole)?
No but this rail design is similar to the large crane that it is use to unload containers from a ship to a pier. Stepper motor systems exist for laboratory movement of sensors also.

Will it require assembly on the seafloor, other than plugging in the cable and connector*? yes*

How accurately will it have to be positioned (horizontal, vertical, orientation)?

The different parts of the "railbed" need to be place accurately relative to one another - otherwise the rail will not move.

What are expected (planned) servicing requirements?

What will need to be done?
Clean the rail, and verify the motor positioning accuracy.

How often?
Unknown, but with the placement of a ruler somewhere in the survey grid this can be done very easily. We suggest that this can be confirmed every time a grid survey is done with the camera system.

How long will it take?
Unknown

Who will be responsible for the costs?
Unknown

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Unknown

Will emergency servicing be expected if the observing system fails?
Who will be responsible for the decision?
Archambault, Desrosiers, Metaxas, Snelgrove, Tunnicliffe

Who will be responsible for the cost? *Unknown*

Section 12: Documentation

What documentation is available?
To my knowledge there is no documentation available on a full system but there should be documentation available with vendors of stepper motors.

on the science plan
None

on the sensors and measurement techniques
For sensors yes, and for stepper motors yes.

on the design and specification of the observing system
No

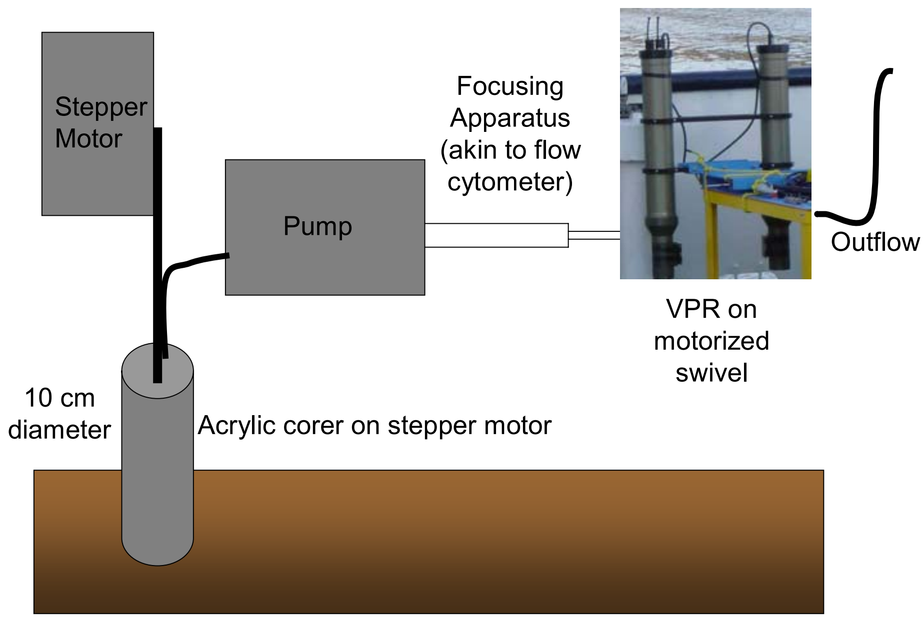
What information and documentation will be needed?
Develop a users manual for the traverse system

Component : SedView sediment imaging system

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
SedView in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology"

Person to contact for information: *Paul Snelgrove*



Purpose of the observing system: *Suck sediment through corer and pump through a focusing system that sends particles in single line past VPR for optical imaging.*

What questions are the observations intended to answer?
Abundance and composition of sedimentary infauna

Who is responsible for specification of the observing system?
Snelgrove

Who are expected to be the initial users of data from this observing system?
Deep sea benthic ecosystem team (Snelgrove, Archambault, Desrosiers, McKindsey, Metaxas Tunnicliffe)

Is there a specific feature or site where the observing system must be located?
2 sites- Barkley Canyon and Poseidon Deep

What is(are) the nearest NEPTUNE Canada node(s)?
See above

How far is this from the observing system site?
Can be within 100 m of main node depending on footprint of disturbance from node deployment. Would be used in concert with the Car-Rail System.

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Instrument will use stepper motor to push core into sediment, pump will suck out sediment, and focusing system will orient particles and sedimentary organisms (size range of 0.05 to 3 mm) and focus them through a single tube that can be imaged by the VPR (see Don Deibel user scenario). Images will be collected as per the VPR system. Note that this sort of particle focusing is used in Flow Cytometers (e.g. Flowcam – see http://aslo.org/meetings/santafe99/abstracts/CS69WE0730S.html

How often will measurements be taken?
Typically this might be done once every few weeks though perhaps every few days during interesting events.

Will this change according to conditions, and how?
Yes, during flux events might want to do measurements up to once per day.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Might miss some key events but that is always a risk.

How often will the raw measurements be transmitted to shore, and in what format?
Data will include VPR imaging data, pump activity data, CanRail positioning data, and core insertion data.

> How many bytes of data may be expected in each transmission?
> *VPR data is biggest issue for transmission – others are trivial in comparison.*

What is required to transform the raw measurements into meaningful units?
Location and area of sediment pumped and number of organisms imaged

What format is planned for the data in meaningful units?
X, Y Position in Centimetre units and time stamp, core area (will not change) and images per unit time.

> Is there a commonly accepted standard and what is it?
> *See VPR*

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
Stepper motor for corer may need to be verified. Could do this using camera and markings on core. For VPR and CanRail see those proposals.

How will these corrections be determined*?
See above

How often will they need to be changed*?
Depends on drift of motors but can be checked during each coring event (weekly?)

Who will be responsible for calibration corrections*?
Snelgrove

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.) *Raw Images – see VPR summary from DD.*

Who will be responsible for monitoring the quality of the real-time data?
Snelgrove and other PIs utilizing instruments.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Environmental data such as fluorescence, transmissometer and bottom images from camera system.

What real time NEPTUNE data not provided by this observing system will be needed for the research?
See above. Real time is not really critical but frequent updates (day time scale) could help direct the bottom sampling.

If the complete calibrated data is not available in real time, when will it be available to other users?
See VPR contribution

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Snelgrove

.
Is there an existing disciplinary repository for archived data?
Not really. Systems like OBIS offer a starting point.

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Time and location are critical.

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
To be move corer (CanRail), lower corer into sediment (stepper motor), turn on pump and focusing system, rotate VPR into imaging position, turn on VPR and select Regions of Interest (ROIs).

What events might require action?
Evidence of increased phytodetritus, for example, or a slumping event might result in increased numbers of surveys and thus increased sampling frequency.

What information will be needed to make decisions to initiate an action?
Environmental data such as fluorescence, transmissometer and bottom images from camera system.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
A few seconds before starting to move to the position, initiating coring etc. .

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Serial sequences? Not sure.

What will be the amount and rate of information exchange during a controlled action?
VPR is by far the most significant information exchange…remainder is relatively simple commands.

Section 4: Communications

How often will the observing system communicate with shore?
Will depend on local activities (e.g. bloom flux etc.) but will typically be on the scale of a week to several weeks.

> What is the maximum expected interval between communications?
> *Perhaps a week to a month?*
>
> The minimum?
> *Few minutes*

How much information (bytes) will each communication include? *See VPR summary*

If variable, what are the expected maximum and minimum?
NA
What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
See VPR?

What will be the message format?
?

What will be the impact of a planned interruption in communication, e.g. planned network service?
Possibility of missing an event.
What is planned to minimize the impact?
Nothing is planned

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Possibility of missing an event. Will also need to program the coring and CanRail system system to return to a "home" position during interruptions so that it does not lose track of its position.

What is planned to minimize this impact?
Nothing is planned

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
NA
What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?
NA
If variable, what are the expected maximum and minimum?
NA
What will be the message format?
NA

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
None when in position. But high accuracy is needed for the VPR.

How frequently will the instrument need to receive a time signal?
See VPR

What is the best format for the time signal?

See VPR

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
See VPR

What are the consequences of an interruption in the time signal?
See VPR

Section 6: Power

What voltage is the observing system expecting from the network?
Enough to move corer into position (including CanRail movement and corer movement), activate pump and focusing system, and run VPRs

What is the minimum current required?
This will depend of the motor and pump used.

What fraction of the time will the observing system be drawing the minimum?
Unknown.

What is the maximum current required (e.g. for motors, lights)?
This will depends of the pump and motor used.

How often will this be needed and for how long each time?
As long as it takes to collect, pump, focus and image the core (an hour???).

Is there any intermediate level of current requirement? *No*
If so, how much, and what fraction of time?

What will be the impact of a planned interruption in power, e.g. planned network service?
Will require some programming to ensure unit returns to "home" once power is restored.

What is planned to minimize the impact?
Nothing

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply? *The motors will not move and a possibility of missing an event.*

What is planned to minimize this impact? *Nothing*

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *Yes*
What will be the source and nature of the **sound**? *Two stepper motors to move an instrument package along and across the rail.*

What frequencies and power levels? *Unknown*

How often? *Unknown*

What is the duration of the **sound**s? *Few minutes each time*

If directional, how will it be directed? *NA*

Will sound from other sources interfere with measurements by the observing system? *No*

What power levels, frequencies or other characteristics would result in interference? *Unknow*

Will the observing system emit **light**? *VPR will, as will camera if that is used to observe coring activity.*

What will be the source and nature of the **light**? *VPR, Bottom camera*

What colour and power levels? *Unknown – see VPR and camera summaries*

How often? *During imaging, perhaps once a week to once month*

What is the duration of the light? *Strobe, unknown how long it would take to image sample.*

If directional, how will it be directed? *NA*

Will light from other sources interfere with measurements by the observing system? *No*

What colour, intensity or other characteristics would result in interference? *NA*

Will the observing system be a source of **vibration**? *Yes*
What will be the cause and nature of the **vibration**? *Motor in action*.

What frequencies and power levels? *Unkown*

How often? *During coring…perhaps once a week to once a month.*

What is the duration of the vibration? Only *during the use of motor to reach the position.*

Will vibration from other sources interfere with planned measurements?
Yes, VPR cannot vibrate relative to focusing tube through which organisms are directed.

What characteristics will cause vibration to interfere?
NA

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *If we don't place the pump outflow far afield it will*

What will be the cause of the **turbidity**?
Pumping of sediments through imaging tube

How often and for how long?
Perhaps an hour or two per week?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem? *This system will be used to study sedimentary fauna, so although the functioning of the motors etc. will be unaffected by turbidity the measurements it helps to collect would become meaningless.*

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *Yes,*

What will be the cause and nature of the effect? *Any physical structure will attract mobile organisms and eventually fouling organisms will also become established.*

Are the planned measurement sensitive to effects on **the community** due to other experiments?

What kinds of effects would be a problem?
The attraction but we need to deal with it

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling? *NO*

What will be the source and nature of the effect?
NA

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? *Nonly if large amounts of contaminants were released*

What kinds of effects would be a problem? *NA*

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *Probably*

What will be the cause and nature of these currents or gradients?
The stepping motors will be electric

What characteristics?
Unknown

How often?
Depends on sampling frequency but a few hours every few days at most.

What is the duration of the electrical effects?
Unknown

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
No

What characteristics will cause interference?
NA

Are there any **other potential sources of interference**?
No

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Unknown, but probably more an issue in Barkley Canyon (see position of the site)

What precautions are planned against damage by fishing?
None, but we expect that this is a general issue for the Barkley site in particular.

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Unknown

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Unknown, but individual user universities do keep computers updated with Antivirus software.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
Unknown

How, where and when will the observing system be tested to establish its reliability*?
Unknown. Ideally we might wish to test it in Bonne Bay but because of the physical structures involved (i.e. railbed) it might only be possible to test the Sedview portion by itself.

Has a reliability analysis been conducted?
No, given that system does not exist in an off-the-shelf format (though stepper motors for this sort of application do exist).

What is the probable failure rate?
Unknown

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Sit on the seafloor (see picture at page 1)

Does the sea floor need to have particular characteristics?
Soft sediment, though a similar approach could also conceivably be used at a vent site.
What?

What other characterstics should the site have?
Relatively flat area with no adjacent topographic highs etc.

Will it be self-contained or is it expected to mount on or in another structure?
This is the structure that will support many instruments

> Does this structure already exist (e.g. ODP borehole)?
> *No but elements of it do (flow cytometer focuses particles, stepper motors are widely used to move instruments around, and VPR is used to image plankton.*
> Will it require assembly on the seafloor, other than plugging in the cable and connector? *yes*

How big is it likely to be (height, width, depth, weight)?
Unknown, but perhaps 0.5m x 0.5 m by 1m (???)

How accurately will it have to be positioned (horizontal, vertical, orientation)?
The position is important in relation to the habitat (see above).

Does it require protection from biofouling? *yes*
What is planned? *paint*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
Unknown

> How far is it likely to be from a Science Node?
> *Unknown, but can be as close as 100 m if that works for other groups.*

What are the impacts of a planned interruption to the connection to the network*?
See above.

What are the impacts of an unplanned interruption to the network connection*?
See above.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
Self contained.

> Does this structure already exist (e.g. ODP borehole)?
> *No but this rail design is similar to the large crane that it is use to unload containers from a ship to a pie*r. *Stepper motor systems exist for laboratory movement of sensors also.*
>
> Will it require assembly on the seafloor, other than plugging in the cable and connector*? yes*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
The different parts of the "railbed" need to be place accurately relative to one another - otherwise the rail will not move. The swivel system for the VPR must place the imaging tube accurately in front of the imaging tube (mm scale precision)

What are expected (planned) servicing requirements?

> What will need to be done?
> *Verify the motor positioning accuracy. See also VPR*
>
> How often?
> *Unknown, but with the placement of a ruler somewhere in the survey grid this can be done very easily. We suggest that this can be confirmed every time a grid survey is done with the camera system.*
>
> How long will it take? *Unknown*
>
> Who will be responsible for the costs?*Unknown*

How far in advance must the servicing schedule be known to have minimum impact on use of the data?*Unknown*

Will emergency servicing be expected if the observing system fails?

Who will be responsible for the decision?
Snelgrove, Archambault, Desrosiers, Metaxas, Tunnicliffe

Who will be responsible for the cost? *Unknown*

Section 12: Documentation

What documentation is available?
To my knowledge there is no documentation available on a full system but there should be documentation available with vendors of stepper motors. See also VPR.

on the science plan
None

on the sensors and measurement techniques
For sensors yes, and for stepper motors yes.

on the design and specification of the observing system
No

What information and documentation will be needed?
Develop a users manual for the traverse system as well as the focusing system and VPR.

Observing System 2: Bottom mounted "bare bones" system for "The Effects of Perturbations on Benthic Boundary Layer Biology"

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
The Effects of Temporal and Spatial Variation in Upper Ocean Processes on Benthic Boundary Layer Biology and Material Flux

Person to contact for information: *Don Deibel*

Purpose of the observing system: *To measure in situ fluorescence and water transmittance continuously, near bottom. The system could also include temperature and salinity if there are no other nearby sources of this information. The benthic still camera would be located nearby*

What questions are the observations intended to answer?
Basic biological characteristics of the near bottom environment.

Who is responsible for specification of the observing system?
Deibel/Group.

Who are expected to be the initial users of data from this observing system?
Deibel/Group.

Is there a specific feature or site where the observing system must be located?
We are proposing to deploy the bare bones system at three site: Poseidon Shallow, IODP Deep and ODP1027.

What is(are) the nearest NEPTUNE Canada node(s)?
Poseidon Shallow, IODP Deep and ODP1027.

How far is this from the observing system site?
Within 10 m

Section 2: Data

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Sensors

How often will measurements be taken?
Continuously, logging all sensors at a maximum rate of 2 Hz.

Will this change according to conditions, and how?
Probably not..

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Might miss some key events but that is always a risk. Scheduled downtime would likely be least risky during winter.

How often will the raw measurements be transmitted to shore, and in what format?
Data is transmitted to shore in real time in raw Seabird format (I think ASCII, but I need to check.)

> How many bytes of data may be expected in each transmission?
> *I will check with de Young.*

What is required to transform the raw measurements into meaningful units?
Dedicated software from the supplier.

What format is planned for the data in meaningful units?
Digital spreadsheet.

> Is there a commonly accepted standard and what is it?

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
All sensors will be calibrated prior to deployment.

How will these corrections be determined*?
Not sure.
How often will they need to be changed*?
> *See above.*

> Who will be responsible for calibration corrections*?
> *Deibel and team.*

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
Yes

Who will be responsible for monitoring the quality of the real-time data?
Deibel and team.

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Near bottom current velocity and direction.

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Ditto above.

If the completed calibrated data is not available in real time, when will it be available to other users?
Within hours. QA/QC will take longer.

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Deibel and team.

Is there an existing disciplinary repository for archived data?
Yes.

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
User supplied software has comprehensive header. May want to add a line defining the node.

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Off/on, ideally to be able to change the gain on the fluorometer.

What events might require action?
Large phytodetritus pulse may require reducing gain of fluorometer.

What information will be needed to make decisions to initiate an action?
Values of state variables.

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
10's of seconds.

What is the expected format of commands (e.g. serial sequences, web-based frames)?
Don't know

What will be the amount and rate of information exchange during a controlled action?
Don't know,.

Section 4: Communications

How often will the observing system communicate with shore?
Data will be transmitted continuously. Control communications might be daily to weekly.

What is the maximum expected interval between communications?
See above.

The minimum?

How much information (bytes) will each communication include?
Don't know.

If variable, what are the expected maximum and minimum?
Don't know.

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
Don't know but assume 100 BaseT. Will ask de Young.

What will be the message format?
Don't know.

What will be the impact of a planned interruption in communication, e.g. planned network service?
We may miss exciting, short term perturbation events.

What is planned to minimize the impact?
We request that scheduled downtime is in the winter months.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
No problem.

What is planned to minimize this impact?

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Has not been discussed.

What is the maximum expected interval between communications?
See above.

The minimum?
Don't know.

How much information (bytes) will each communication include?
See above.

If variable, what are the expected maximum and minimum?
See above.

What will be the message format?
See above.

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
10-100 millisec

How frequently will the instrument need to receive a time signal?
I am guessing that daily would be sufficient, but it is only a guess.

What is the best format for the time signal?
Don't know, ask de Young.

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Milli.

What are the consequences of an interruption in the time signal?
We may be unable to synch data with other instruments, rending the data of limited value for interpretation.

Section 6: Power

What voltage is the observing system expecting from the network?
12-15 V.

What is the minimum current required?
Will have to check.

What fraction of the time will the observing system be drawing the minimum?
Don't know.

What is the maximum current required (e.g. for motors, lights)?
Will have to check but am guessing no more than 2 amps.

How often will this be needed and for how long each time?
Continuously.

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
No.

What will be the impact of a planned interruption in power, e.g. planned network service?
See above.

What is planned to minimize the impact?
See above.

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
See above.

What is planned to minimize this impact?
See above.

Section 7: Emissions and sensitivity

Will the observing system emit **sound**? *No.*
What will be the source and nature of the **sound**?

What frequencies and power levels?
Don't know.

How often? *Continuously.*

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?
No.

What power levels, frequencies or other characteristics would result in interference?
Unknown.

Will the observing system emit **light**? *Yes.*
What will be the source and nature of the **light**? *Fluorometer strobe in blue range and continuous transmissometer in the red range.*
What colour and power levels?
Not sure about the power levels, but they emit very low intensities of light.

How often?
Continuously.

What is the duration of the light?
See above.

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?
Yes.

What colour, intensity or other characteristics would result in interference?
Blue and red, but intensities are difficult to estimate.

Will the observing system be a source of **vibration**? *No.*
What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?
No.

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?

No.

What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?
Yes. Any level above ambient.

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
The low light intensities are not expected to affect organism behaviour.

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments?
Don't understand question.

What kinds of effects would be a problem?

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
No.

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?
No, except local heating would not be a good idea.

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?**
Don't know, will have to ask Seabird.

What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
I think no.

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Don't know. See node selection above.

What precautions are planned against damage by fishing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Had not thought about this as yet.

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
Ditto above.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
None.

How, where and when will the observing system be tested to establish its reliability*?
Field tested at the Bonne Bay Cabled Observatory, before being shipped to Victoria for deployment.

Has a reliability analysis been conducted?
No.

What is the probable failure rate?
Unknown. Seabird must have data on this.

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Sit on the seafloor.

Does the sea floor need to have particular characteristics? *Yes.*

What? *Relatively flat.*

What other characterstics should the site have?
None.

Will it be self-contained or is it expected to mount on or in another structure?
Self contained.

Does this structure already exist (e.g. ODP borehole)? *No.*

Will it require assembly on the seafloor, other than plugging in the cable and connector?
The instrument will not need assembly on the seafloor. It may need mounted on the seafloor, or not, I don't know. Likely it will require only plugging the instrument into the node box.

How big is it likely to be (height, width, depth, weight)?
Approximately 1.5 m high, 0.3 m wide, 0.3 m deep and ca. 20 kg in air.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Should be maintained close to vertical.

Does it require protection from biofouling?
What is planned?
Yes. Satlantic has many solutions in hand. It has two optical surfaces, and they both must be protected from biofouling. Talk to Scott from SatLantic.

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
At this point, I have no idea.

How far is it likely to be from a Science Node?
No more than 20 m, probably.

What are the impacts of a planned interruption to the connection to the network*?
See above.
What are the impacts of an unplanned interruption to the network connection*?
See above.

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
See above.

Does this structure already exist (e.g. ODP borehole)?
See above.

Will it require assembly on the seafloor, other than plugging in the cable and connector? *See above.*

How accurately will it have to be positioned (horizontal, vertical, orientation)?
See above.

What are expected (planned) servicing requirements?
What will need to be done?
Clean optical surfaces, check calibration factors.

How often? *Annually should be sufficient.*

How long will it take? *ca. 1 day.*

Who will be responsible for the costs?
Has not been discussed. First guess might be that since this must be a basic instrument of importance to almost all groups in NEPTUNE, it should be a network expense.

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Minimum of one month in advance.

Will emergency servicing be expected if the observing system fails? *Yes.*

Who will be responsible for the decision? *Deibel/Metaxas/Snelgrove in consultation with Chief Scientists.*

Who will be responsible for the cost? *Network.*

Section 12: Documentation

What documentation is available?
Don't understand the question.

on the science plan
Don't understand the question.

on the sensors and measurment techniques
Manual from Seabird.

on the design and specification of the observing system
Ditto above.

What information and documentation will be needed?
Don't understand the question.

Observing System 3 Larval Pump in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology and Material Flux"

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Larval Pump in Support of "The Effects of Perturbations on Benthic Boundary Layer Biology and Material Flux"

Person to contact for information: *Anna Metaxas, Claudio DiBacco, Paul Snelgrove*

Purpose of the observing system: *To sample plankton (meroplankton& holoplankton) and particulates (organic and inorganic).*

What questions are the observations intended to answer?
Provide physical samples of organic particulates in 2 size classes;
>65 μm,
<65μm, but >0.45mm

Who is responsible for specification of the observing system?
Anna Metaxas, Claudio DiBacco

Who are expected to be the initial users of data from this observing system?
Anna Metaxas, Claudio DiBacco, Paul Snelgrove, Don Deibel, Kim Juniper

Is there a specific feature or site where the observing system must be located?
Barkley Canyon
Poseidon Deep

What is (/are) the nearest NEPTUNE Canada node(s)?
Barkley Canyon
Poseidon Deep

How far is this from the observing system site?
Can be within 100 m of the main node.

Section 2: Data

What is the nature of measurements?
Filtered seawater samples retained on Nitex mesh. Sample will be preserved (preservative to be determined) and held until the vehicle is recovered on a quarterly to semi-annual time period.

How often will measurements be taken?
One sample a week, except during perturbation events.
Based on a pump rate of $1m^3 \cdot 3min.^{-1}$*, we anticipate pumping for 6 hours (ca.* $120m^3$ *or 120,000 L).*

Will this change according to conditions, and how?
Yes, during perturbation events sampling frequencies as high as once per day may be implemented.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Planned weekly sampling is unlikely to be significantly impacted by short term interruptions (i.e., <1 week). Higher frequency sampling to target perturbation events might miss some key events, which is an accepted risk.

How often will the raw measurements be transmitted to shore, and in what format?
The only real-time data transmitted to shore during pumping operations are flow meter readings (i.e., pump rate) every 30 seconds to monitor pump performance and the final volume of seawater sampled at the end of the 6 hour pumping session. No other measurements are required for transmission to shore.

How many bytes of data may be expected in each transmission?
A number reporting pumping activity every 30 seconds during pumping operations only.

What is required to transform the raw measurements into meaningful units?
We don't know what flowmeter we will be incorporating in this unit. Once design specifications are available, this information will be provided.

What format is planned for the data in meaningful units?
Flow rate units (e.g., litres per minute) and total volume pump after each pumping session (litres).

Is there a commonly accepted standard and what is it?
Yes, see last response above.

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
The initial 5 minutes of each sample session will involve pumping water without filtering. This data will serve 2 purposes, including;

- *monitor any long-term changes in pump efficiency over the duration of time that the pump is deployed, and*
- *monitor short term changes in pumping efficiency resulting from clogged filters inhibiting flow.*

The flow meter will also be tested and rate of flow measured during servicing.

How will these corrections be determined*?
The rates of flow data will be collected as part of the in situ filtering protocols.

How often will they need to be changed*?
Pumps need to be serviced minimum of 4 times a year (to maintain the quarterly sampling program described above).

Who will be responsible for calibration corrections*?
A. Metaxas, C. DiBacco

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
Flow meter rates during pumping operations.

Who will be responsible for monitoring the quality of the real-time data?
A. Metaxas, C. DiBacco

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
Surface and bottom measures of current velocity, turbidity, fluorescence.

What real time NEPTUNE data not provided by this observing system will be needed for the research?
Surface and bottom measures of current velocity, turbidity, fluorescence.

If the complete calibrated data is not available in real time, when will it be available to other users?
Within one year of servicing the pumps.

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
A. Metaxas, C. DiBacco, P. Snelgrove, D. Deibel, K. Juniper

Is there an existing disciplinary repository for archived data?
No

What information should be included in meta-data from this observing system? (The NEPTUNE data policy will include requirements, but these are still under development)

- *Date,*
- *Location,*
- *Time,*
- *Depth,*
- *Flow rate of pumps,*
- *Particle concentration (e.g., taxonomic counts, organic content, particle size distribution)*

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Instigate a pre-programmed sample frequency; turn pump on/off; turn a water flow bypass system on/off (to bypass clogged filters). Note that the bypass action requires a time stamp or amount of seawater filtered up to the point of instigating the bypass so concentrations of particles collected to that point in time can estimated.

What events might require action?
Regularly scheduled events (weekly) and perturbation events (e.g., plankton dump).

What information will be needed to make decisions to initiate an action?
Surface and bottom measures of current velocity, turbidity, fluorescence

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
Hours, but once pumping has been initiated no interruptions please.

What is the expected format of commands (e.g. serial sequences, web-based frames)?
We don't understand the question.

What will be the amount and rate of information exchange during a controlled action?
Command to sample and monitor flow rate (see above – very low data volume)

Section 4: Communications

How often will the observing system communicate with shore?
During each sampling event (see above).

What is the maximum expected interval between communications?
Weekly

The minimum?
Every 30 seconds for flow rate date.

How much information (bytes) will each communication include?
See above, but negligible (flow rate data and commands to initiate pump).

If variable, what are the expected maximum and minimum?
N/A

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
Pump dependent. Don't have pump specifications yet.

What will be the message format?

Don't know.

What will be the impact of a planned interruption in communication e.g. planned network service?
We will be able to work around planned interruptions.

What is planned to minimize the impact?
Delay or reschedule initiation of pump sampling.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Weekly samples can be rescheduled, but event driven sampling will have to be evaluated at the time.

What is planned to minimize this impact?
None

How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
Not planned.

What is the maximum expected interval between communications?
N/A

The minimum?
N/A

How much information (bytes) will each communication include?
N/A

If variable, what are the expected maximum and minimum?
N/A

What will be the message format?
N/A

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?
Within 30 minutes.

How frequently will the instrument need to receive a time signal?
Daily

What is the best format for the time signal?
Army time (24 hr clock)?

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Seconds

What are the consequences of an interruption in the time signal?
Minimal if flow meter data is recorded accurately

Section 6: Power

What voltage is the observing system expecting from the network?
Don't know; somewhere between 12V (if single phase) or 110-220V (if 3-phase pump).
To be determined.

What is the minimum current required?
To be determined.

What fraction of the time will the observing system be drawing the minimum?
To be determined, but likely none since the pump should have a clock battery.

What is the maximum current required (e.g. for motors, lights)?
See first question above.

How often will this be needed and for how long each time?
6 hours for each sampling event

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
Not anticipated at this time.

What will be the impact of a planned interruption in power, e.g. planned network service?
Minimal.

> What is planned to minimize the impact?
> *Reschedule sampling collection.*

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?
If this occurs during sampling, the sample will likely have to be thrown out and rerun at the next available opportunity.

What is planned to minimize this impact?
N/A

Section 7: Emissions and sensitivity

Will the observing system emit **sound**?
Yes, only during pumping operations.

What will be the source and nature of the **sound**?
The pump, but we will investigate the possibility of insulating it to reduce sound levels further.

What frequencies and power levels?
No idea.

How often?
Roughly 6 hours per week.

What is the duration of the **sound**s?
Roughly 6 hours per weekly sampling event.

If directional, how will it be directed?
Not directional.

Will sound from other sources interfere with measurements by the observing system?
No.

What power levels, frequencies or other characteristics would result in interference?
None

Will the observing system emit **light**?
No.

What will be the source and nature of the **light**?
N/A

What colour and power levels?
N/A

How often?
N/A

What is the duration of the light?
N/A

If directional, how will it be directed?
N/A

Will light from other sources interfere with measurements by the observing system?
N/A

What colour, intensity or other characteristics would result in interference?
N/A

Will the observing system be a source of **vibration**?
Yes, but negligible.

What will be the cause and nature of the **vibration**?
Pumping

What frequencies and power levels?
Don't know.

How often?
During 6-hour sampling periods.

What is the duration of the vibration?
6 hour intervals per sampling event (mostly weekly)

Will vibration from other sources interfere with planned measurements?
No

What characteristics will cause vibration to interfere?
N/A

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments?
Only deployment and recovery operations (i.e., servicing).

What will be the cause of the **turbidity**?
See last question.

How often and for how long?
See last w questions.

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?
The SIS (sediment imaging system) will pose potential problems, but coordinating with the operators of this system (i.e., P. Snelgrove) will prevent any conflicts.

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights?
Yes for zooplankton and fish attracted to structures.

What will be the cause and nature of the effect?
See last question

Are the planned measurement sensitive to effects on **the community** due to other experiments?
Yes, sediment resuspension in particular as described above.

What kinds of effects would be a problem?
See last question

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?
No

What will be the source and nature of the effect?
N/A

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments?
Yes. Any contamination that affects zooplankton behaviour, survivorship, etc. could negatively impact sampling.

What kinds of effects would be a problem?
E.g., Oil leakage, sulphide production/release

Will the observing system be a source of **electrical currents or gradients of electrical potential?**
No.

What will be the cause and nature of these currents or gradients?
N/A

What characteristics?
N/A

How often?
N/A

What is the duration of the electrical effects?
N/A

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?
N/A

What characteristics will cause interference?
N/A

Are there any **other potential sources of interference**?
?????

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
The sampling site most likely impacted by fishing is Barkley Canyon. Bottom trawling could potentially snag gear. I am not familiar with fishing practices in this area.

What precautions are planned against damage by fishing?
Presumably, fishermen will be made aware of experimental sites. Will there be guard buoys?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the system seawards will include protection against unauthorized access by computer 'hackers'.)
I do not know, but there does not seem to be much opportunity for hackers accessing this pump system.

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?
None presently, though all PIs have antivirus software that is regularly updated.

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?
None presently. We expected that if the system fails, that it will shut down without affecting other systems.

How, where and when will the observing system be tested to establish its reliability*?
We have no such plans. Certainly, it will be tested by the manufacturer and perhaps we will try a shallow water deployment at Bonne Bay (20m) and VENUS test site prior to deploying at Neptune.

Has a reliability analysis been conducted?
No, partly because the system doers not exist as an integrated of the shelf unit. However, this will be requested of any system that is eventually built or contracted.

What is the probable failure rate?
Not known yet, because system does not exist..

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
It will be sitting on the seafloor. We are exploring the option that it might have extensions to allow sampling up to 5 meters above the seafloor.

Does the sea floor need to have particular characteristics?
No. It should be able to sit on any sort of bottom. However, rocky uneven bottom may require some effort to ensure that it is positioned on level ground and away from any local topographic highs (e.g. not in the lee of an outcrop).

What?

What other characteristics should the site have?
Larvae.

Will it be self-contained or is it expected to mount on or in another structure?
The unit we envision will be self contained; however, there has been limited discussion whether part of the unit (e.g pump intake) may be attached to an ROV in order to allow spatial variability in larva sampling protocols.

Does this structure already exist (e.g. ODP borehole)?
Yes…the seafloor.

Will it require assembly on the seafloor, other than plugging in the cable and connector?
No, unless it requires anchoring to the bottom.

How big is it likely to be (height, width, depth, weight)?
[approximately, 3m ht., 3m diameter, 200-300 kg)

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Note particularly accurately….within 10's of meters.

Does it require protection from biofouling?
Yes, perhaps more for the shallower site (Barkley Canyon, 250m). Portions of the instrument (intake ports) represent particularly sensitive areas of the unit, but it is not expected to be nearly as sensitive as optical sensors. But we are leery of antifouling paint because it may alter larval behaviour.

What is planned?
I am not aware of any plans as yet. However, we will explore a variety of antifouling coatings/strategies as necessary.

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
As far as I recall, both units will be plugging into science ports, though our group has talked about running extension cords as a scenario in the Barkley Canyon site as a measure of protection against potentially damaging slumping events.

How far is it likely to be from a Science Node?
If the pump is put on an extension cord, it would like be 5m or less.

What are the impacts of a planned interruption to the connection to the network*?
We can work around planned interruptions in most case. Extended interruptions of weeks will cause considerable consternation.

What are the impacts of an unplanned interruption to the network connection*?
Unplanned interruptions can be problematic depending on timing. It seems we are in an enviable position considering that our unit will be working between 6-20 hors a week, which leaves a significant amount of down time where unplanned interruptions will not have much of an effect. The greater effect is likely to be in the loss of ancillary data (e.g. organic matter pulses etc.)

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?
At this point, we expect it will be a self contained unit.

Does this structure already exist (e.g. ODP borehole)?
N/A

Will it require assembly on the seafloor, other than plugging in the cable and connector?
No, unless it requires anchoring to the bottom.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Note particularly accurately….within 10's of meters.

What are expected (planned) servicing requirements?

What will need to be done?
Servicing entails removing preserved samples from the unit and installing a new set of sample collectors. This requires hauling the unit onboard a ship for servicing.

How often?
At the anticipated sample collection rate, the pump unit will have to be serviced approximately every 3 (minimum) to 6 (maximum) months.

How long will it take?
Hauling the unit, on deck servicing, and redeploying will require 3-4 hours. Ship transit time not included.

Who will be responsible for the costs?
We anticipate piggy-backing on Neptune service cruises as ships of opportunity.

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
2-3 months?

Will emergency servicing be expected if the observing system fails?
Who will be responsible for the decision?
A. Metaxas, C. DiBacco

Who will be responsible for the cost?
Our preferred option is to take advantage of Neptune service cruises, time permitting. Alternatives include hiring a ship with the capability of retrieving the unit for servicing. This cost will be shared among principal users. (????)

Section 12: Documentation

What documentation is available?

- on the science plan

None currently available.

- on the sensors and measurement techniques
- on the design and specification of the observing system

This unit is not presently available off the shelf. There is no specific documentation available at this time on either the components (pump, filtration unit, preservation system) or the design of this unit. Units that do approximately similar sorts of things are sold by McLane and by a French company Verena knows, but large volumes and double filtration are somewhat unique to our application.

What information and documentation will be needed?
This instrument will consist of 5 basic components, including;

1. *pump and flow meter to sample seawater at a known rate*
2. *a filtration system to sieve particles from seawater,*
3. *a preservation system to maintain samples for up to 6 months until they are retrieved, and*
4. *a lazy susan (e.g. Hardy-Longhurst style) spooling system to allow multiple samples.*
5. *a frame to house the various components listed above.*

Observing System 4 Camera for "The Effects of Perturbations on Benthic Boundary Layer Biology"

Section 1. Overview of Purpose and Interests

Name or title of the observing system:
Benthic still camera
Person to contact for information:
Verena Tunnicliffe
Purpose of the observing system:
Periodic imagery of the seafloor

What questions are the observations intended to answer?

1. Is surface productivity delivered to the seafloor concurrently throughout the NEPTUNE observing area?
2. What is the benthic mega- and macrofaunal response to surface input pulses?
3. What is the relative level of activity of bioturbation down the slope and into the bathyal region?
4. What interesting answers are there to questions we haven't posed?

Who is responsible for specification of the observing system?
The Ecosystem Group
Who are expected to be the initial users of data from this observing system?
Most members of said Group. Lots of student projects possible.

Is there a specific feature or site where the observing system must be located?
Dispersed – it represents the least instrument complexity to gather first order information from all available sites.

What is(are) the nearest NEPTUNE Canada node(s)?
All of them.

How far is this from the observing system site?
Within 10s metres.

I don't find a spot to describe the system:

Digital camera with low res video capacity:
Two 250 watt-sec strobes
Three 200 watt video lights
Three laser beams
All mounted on a pan and tilt unit attached to a tripod.
See attached spec sheet

<u>Section 2: Data</u>

What is the nature of measurements: in-situ sensors, images, video, sounds.....?
Digital images.

How often will measurements be taken?
1. *Upon user request.*
2. *Selected intervals but likely not greater than 6 per day.*

Will this change according to conditions, and how?
Event response likely would increase rate – i.e. big plankton fall.

What are the consequences of interruptions of a few hours, a day, several days, a month*?
Probably great rejoicing and students taking holiday.
Little in the first years.

How often will the raw measurements be transmitted to shore, and in what format?
Data can be transmitted after each collection or stored on board and transmitted once a day depending on need.

How many bytes of data may be expected in each transmission?
2 to 20 MB depending on frequency of upload.

What is required to transform the raw measurements into meaningful units?
Capture software provided.

What format is planned for the data in meaningful units?
JPG images
Is there a commonly accepted standard and what is it?

What calibration corrections will be needed to maintain the accuracy of the data in meaningful units?
Laser distance separation may need checking.
How will these corrections be determined*?
Could use a standard scale at one end of the pan & tilt range.

How often will they need to be changed*?

Who will be responsible for calibration corrections*?

What data will be available in real-time? (NEPTUNE data policy requires that some data be available in meaningful units in real time for allow other users to recognize changes and events that may affect their own observations.)
Images fresh off the bottom.

Who will be responsible for monitoring the quality of the real-time data?
N/A

What data (NEPTUNE or otherwise) not provided by this observing system will be needed for the research?
N/A

What real time NEPTUNE data not provided by this observing system will be needed for the research?
N/A

If the complete calibrated data is not available in real time, when will it be available to other users?
N/A

Who will be responsible for quality control of 'final' data to be stored in the NEPTUNE DMAS and other disciplinary repositories?
Don't know – may become a problem in terms of volume.
.
Is there an existing disciplinary repository for archived data?
no

What information should be included in meta-data from this observing system?(The NEPTUNE data policy will include requirements, but these are still under development)
Camera attitude, laser separation and activation,

Section 3: Control

What actions can be taken with the planned observing system (NEPTUNE policy will require at least the ability to turn it on and off)?
Pan, tilt, video lights, video stream, lasers on/off, camera trigger

What events might require action?
Any disruptive visual event.

What information will be needed to make decisions to initiate an action?

What is the maximum system delay (latency) acceptable during a controlled action, e.g. focussing a camera?
On the order of seconds i.e. fairly long.

What is the expected format of commands (e.g. serial sequences, web-based frames)?
The latter.

What will be the amount and rate of information exchange during a controlled action?
Ummm – don't know?

Section 4: Communications

How often will the observing system communicate with shore?

What is the maximum expected interval between communications?
Once a day
The minimum? *Every 10 seconds*

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?
2 to 512 MB

What communication bandwidth/protocol is planned (RS232, 100BaseTEthernet...)
Latter

What will be the message format?

What will be the impact of a planned interruption in communication, e.g. planned network service?

What is planned to minimize the impact?
Don't know this one – there will be an on-board battery but I don't know how long it will last.

What will be the impact of an unplanned interruption in communication, e.g. failure of at some point in the communication chain?
Shouldn't be a problem.

What is planned to minimize this impact?
How often will the observing system at any one site communicate with observing systems at other NEPTUNE sites?
N/A
What is the maximum expected interval between communications?

The minimum?

How much information (bytes) will each communication include?

If variable, what are the expected maximum and minimum?

What will be the message format?

Section 5: Timing

What absolute time accuracy is required to synchronize this observing systems' measurements with those of other observing systems?

How frequently will the instrument need to receive a time signal?
Good point – we have to talk to the manufacturer to see how the camera can receive.

What is the best format for the time signal?

The metadata from the instrument should include time. What are the smallest units that should be included? (seconds, milli, micro, nano?)
Minutes sound good at this point!!

What are the consequences of an interruption in the time signal?
little

Section 6: Power

What voltage is the observing system expecting from the network?
24

What is the minimum current required?
1 amp when operating but not charging strobe.
What fraction of the time will the observing system be drawing the minimum?

What is the maximum current required (e.g. for motors, lights)?
2.5 amps to charge the strobes, plus 12 amps if all three video lights

How often will this be needed and for how long each time?
Every image.

Is there any intermediate level of current requirement?
If so, how much, and what fraction of time?
Yes – for pan and tilt.

What will be the impact of a planned interruption in power, e.g. planned network service?

What is planned to minimize the impact?

What will be the impact of an unplanned interruption in power, e.g. failure of at some point in the power supply?

What is planned to minimize this impact?

Section 7: Emissions and sensitivity

Will the observing system emit **sound**?
What will be the source and nature of the **sound**?
Minor motor noise and strobe charging.
What frequencies and power levels?

How often?

What is the duration of the **sound**s?

If directional, how will it be directed?

Will sound from other sources interfere with measurements by the observing system?

What power levels, frequencies or other characteristics would result in interference?

Will the observing system emit **light**?
What will be the source and nature of the **light**?
Yup – big ugly flashes and occasional video lights.

What colour and power levels?
Full spectrum; to 600 watts
How often?

What is the duration of the light?

If directional, how will it be directed?

Will light from other sources interfere with measurements by the observing system?
No
What colour, intensity or other characteristics would result in interference?

Will the observing system be a source of **vibration**? *NO*
What will be the cause and nature of the **vibration**?

What frequencies and power levels?

How often?

What is the duration of the vibration?

Will vibration from other sources interfere with planned measurements?

What characteristics will cause vibration to interfere?

Will operation of the observing system cause an increase in **turbidity**, e.g. by stirring up sediments? *No*
What will be the cause of the **turbidity**?

How often and for how long?

Will **turbidity** from other sources interfere with planned measurements? What levels will be a problem?

Is operation of the observing system expected to affect the **local biological community**, e.g. bait to attract fish, lights? *I suspect we will find out…..*

What will be the cause and nature of the effect?

Are the planned measurement sensitive to effects on **the community** due to other experiments? *Yes*

What kinds of effects would be a problem?
Anything that disturbs the bottom in the field of view.

Is the operation of the observing system expected to affect the **water chemistry**, e.g. by releasing reagents or antifouling?

What will be the source and nature of the effect?

Are the planned measurement sensitive to effects on **water chemistry** due to other experiments? *No*

What kinds of effects would be a problem?

Will the observing system be a source of **electrical currents or gradients of electrical potential?** *No idea*
What will be the cause and nature of these currents or gradients?

What characteristics?

How often?

What is the duration of the electrical effects?

Will electrical currents or gradients of electrical potential from other sources interfere with planned measurements?

What characteristics will cause interference?

Are there any **other potential sources of interference**?

Section 8: Security and Reliability

Will the observing system be in water which is subject to fishing?
Shallower sites

What precautions are planned against damage by fishing?
Ummm – nothing?

What measures are planned in the user's facilities to guard against unauthorized access to the system on the Internet side of the Data Management System? (The NEPTUNE system itself, from the Data Managment system seawards will include protection against unauthorized access by computer 'hackers'.)
Can't answer any of these…

What measures are planned in the user's facilities to guard against the introduction of computer viruses on the Internet side of the Data Management System?

What precautions are being taken to ensure that a failure of this observing system has little or no impact on the overall network?

How, where and when will the observing system be tested to establish its reliability*?

Has a reliability analysis been conducted?

What is the probable failure rate?

Section 9: Physical

Will it sit on the seafloor or be in the water column or embedded in the sea floor?
Sit

Does the sea floor need to have particular characteristics?
What? *Flat*

What other characteristics should the site have?
Undisturbed by submersible activity.

Will it be self-contained or is it expected to mount on or in another structure?
Self

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector? *No*

How big is it likely to be (height, width, depth, weight)?
1.5 x 1.5 x 1.5 – guess 70 kg air; 15 water.

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Reasonable aiming required.

Does it require protection from biofouling? *Yes*
What is planned? *Hope to have toxic film application*

Section 10: Interface to the Network

Will the observing system connect directly to a science port, through a Science Instrument Interface, or through an 'Extension Cord"?
SIIM – but I don't think NEPTUNE knows what it will make available yet…

How far is it likely to be from a Science Node?

What are the impacts of a planned interruption to the connection to the network*?

What are the impacts of an unplanned interruption to the network connection*?

Section 11: Installation, Servicing

Will it be self-contained or is it expected to mount on or in another structure?

Does this structure already exist (e.g. ODP borehole)?

Will it require assembly on the seafloor, other than plugging in the cable and connector?
No

How accurately will it have to be positioned (horizontal, vertical, orientation)?
Care needed.

What are expected (planned) servicing requirements?

What will need to be done?
Strobe lights replaced; lenses cleaned.

How often?
Annually

How long will it take?
Recovery and redeployment (or swap with spare)

Who will be responsible for the costs?
Dunno

How far in advance must the servicing schedule be known to have minimum impact on use of the data?
Not long

Will emergency servicing be expected if the observing system fails?
Who will be responsible for the decision?
No – expect many to go down. Best to try some first.

Who will be responsible for the cost?

Section 12: Documentation

What documentation is available?

on the science plan

on the sensors and measurment techniques
Yes, attached

on the design and specification of the observing system

What information and documentation will be needed?
Still need power draws.

Proposal for Cyclops "Venus" Digital Stills Camera Module

C-Map Systems
POB 2309
Red Lodge, MT 59068

Table of Contents

Introduction

The **Cyclops "Venus" Digital Stills Camera Module** is an integrated underwater robotic imaging package specifically optimized to connect to the Venus project "SIIM" centralized underwater hub.

The Cyclops module is comprised of the following components:

- Digital Stills Camera and controller (several options available on digital stills – see camera specifications)
- Pan and Tilt unit
- TTL Electronic Flash Unit
- Video Light Assembly (illumination for video "preview" from stills camera)

The camera/controller package and electronic flash unit are housed in separate cylindrical pressure vessels. These items will be mounted on opposite sides of the pan/tilt head by means of a yoke which straddles the tilt axis of the unit. This will provide optimum mechanical efficiency for the pan & tilt and will also provide 12" (minimum) offset between the camera and the electronic flash to reduce "backscatter" from suspended sediments. The pan and tilt mounting brackets and camera/electronic flash "yoke" will be finalized when details of the host structure are available.

The imaging package is controlled topside via the "SIMM" module Ethernet link. "SIIM" provides 24 vdc, 100T Ethernet and video (twisted pair) connections to the camera module. A WindowsXP software application provides complete camera control, video recording and a still image database.

Camera

Cyclops cameras use "Olympus" commercial digital camera components. Four camera options are available for Cyclops. These offer a range of resolution, aperture and zoom specifications:

- 4 Mega pixel
  - ✓ 10x zoom lens
  - ✓ F2.8
  - ✓ Focal Length 6.3 – 63mm, 11 lenses in 7 groups (38 – 380mm equivalent in 35mm photography)

- 5 Mega pixel "Standard"
  - ✓ 3x zoom lens
  - ✓ F1.8
  - ✓ Focal Length 7.1 –23mm (35 –105mm equivalent in 35mm photography)

- 5 Mega pixel "Wide Angle"
  - ✓ 4x optical zoom lens
  - ✓ F2.8
  - ✓ Focal Length 5.7 – 22.8mm (27 – 110mm equivalent in 35mm photography)

- 8 Mega pixel,
  - ✓ 5x optical zoom lens
  - ✓ F2.4
  - ✓ Focal Length 7.13 – 35.6mm (28 – 140mm equivalent in 35mm photography),15 lenses in 13 groups

Cameras are equipped with 512 megabytes of solid state "on board" memory. Frames are stored to this memory on acquisition and then moved by Ethernet to the surface controller at the operator's convenience.

All of the camera options offer the following features:

Minimum Focus Distance(in air)

- Macro mode – 3"
- Normal mode - 23"(8 mp), 31"(5 mp), 24"(4 mp)

Image Resolution Selections

- 3264 x 2448 – 8 mp only
- 2592 x 1940 – 5-8 mp only
- 2560 x 1696 – 5-8 mp only
- 2288 x 1712
- 2048 x 1536
- 1600 x 1200
- 1280 x 960
- 1024 x 768
- 640 x 480

File Format

- JPEG

Exposure Modes

- Program automatic
- Shutter preferred automatic
- Aperture preferred automatic
- Manual shutter and aperture

Auto Exposure Adjustable Compensation

- +/- 2 Stops in 1/3 stop steps

Metering

- Spot
- Multi-point
- ESP Multi-pattern

Shutter Speed

- 1/2 - 1/1000 sec (16 - 1/1000 sec manual)

Minimum Aperture

- F8

Focus Modes

- Manual
- Spot Auto focus
- Selective Spot Auto focus
- ESP Auto focus

Frame Rate

- 1.5 Frames Per Second

White Balance

- Auto
- Daylight
- Overcast
- Tungsten
- Fluorescent settings

Flash

- Connection for external manual and TTL strobe

Electronic Flash

The Cyclops package includes a separately housed intelligent TTL ("Through the Lens Exposure") electronic flash unit. Flash exposure is automatically controlled using the returned light detected at the camera CCD.

Flash Output is GN 50 (meters in air). When the camera is in auto-focus modes, the unit "pre-flashes" to provide focusing light prior to the primary flash.

Recycle time for the flash is approximately 5 seconds.

The electronic flash is connected to the digital camera via a single underwater cable with wet mateable connectors. This cable carries both power (5 vdc) and TTL exposure control lines.

Pressure Vessels

The digital stills camera/controller and electronic flash unit are housed in cylindrical pressure vessels rated for 300 meters salt water. The camera/controller vessel is 6" dia x 10" length. The electronic flash vessel is 6" diameter x 7" length. (Specifications subject to change).

Construction

- Cyclops Camera - Cylindrical Anodized Aluminum with Optical Acrylic Window
- Electronic Flash – Cylindrical Delrin (machineable plastic) with Optical Acrylic Window

Seals

- Cyclops Camera - Triple O-Ring - Two piston seal rings and one face seal ring
- Electronic Flash – Double piston seal O-rings

Purge/Test Port

- Purge Plug/Vacuum test port with double o-ring plug.

'Soft Touch' End Cap Separation

- Positive pressure hand pump inserts in purge port for gentle 'zero-force' end cap separation

Pan and Tilt Unit

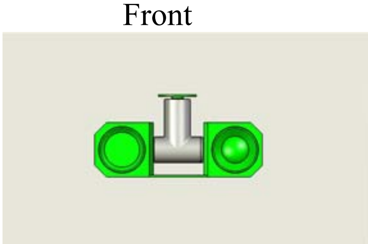
The Cyclops module will be supplied with a "Sidus SS109", oil filled pan and tilt unit. The Pan and Tilt unit is designed for 24 vdc operation. Unlike most pan and tilt units, the SS109 does not require external relay switching of motor power circuits (full motor load through relays) to control motion. The unit operates with a single 24 vdc "mains" source. Motion is commanded by sending ASCII messages via a low voltage RS-232 serial interface. All switching is internal to the Pan and Tilt unit. A single underwater cable (with wet mateable connectors) links the camera/controller to the pan and tilt. It provides both 24vdc power and RS232 control lines.

Attachment Brackets

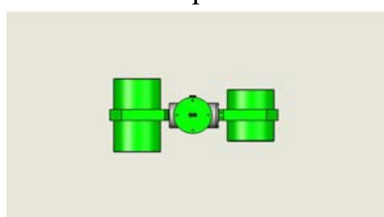
The Cyclops camera and electronic flash pressure housings will be mounted on opposite sides of the pan/tilt head by means of a yoke which straddles the tilt axis of the unit. This will provide optimum mechanical efficiency for the pan & tilt and will also provide 12" (minimum) offset between the camera and the electronic flash to reduce "backscatter" from suspended sediments. Video lights will be mounted on the yoke. The pan and tilt mounting brackets and camera/electronic flash "yoke" will be finalized when details of the host structure are available. Mounting components will be custom fabricated and machined to a high standard.

Brackets will be similar to the "drafting model" below. Pan and Tilt and camera/flash housings are to scale in this rendering (courtesy Sidus, Inc.)

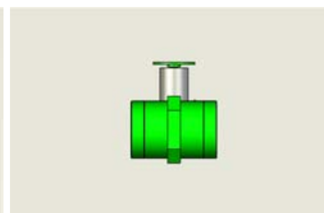
Front



Top



Side



Video Output

The Cyclops camera provides continuous composite video output (PAL, NTSC selectable) for general viewing and composition of digital still shots. For video transmission of "twisted pair" wiring, C-Map Systems recommends use of a passive (no power requirement) video balun to preserve video quality. The balun is a no cost option for Cyclops. C-Map Systems will also provide a matching balun for the SIIM module upon request. The C-Map Systems balun measures approximately 1.5" x 1.5" x 1". Connectors are BNC (video) and screw terminal (twisted pair).

Video Lights

The Cyclops module will be equipped with 3 x 100 watt "Rite-Light" video lights to provide scene lighting for video operations. The video lights will be mounted on the yoke bar which connects the camera and flash unit. Typical bulb life for these units is 2000 hours. Each light is individually switched from the surface control software. This allows the operator to use 1 to 3 lights as needed. Lights will be supplied with spot, medium flood or wide flood reflectors as specified by the customer. The three units can be equipped with identical reflectors, or a mix of reflector.

Local Camera Controller

The Cyclops housing contains a camera control unit which interfaces with the Ethernet, 24 vdc, and analog video connections from the SIIM and provides the various power sources and control functions required to operate the camera, electronic flash, video lights and pan and tilt.

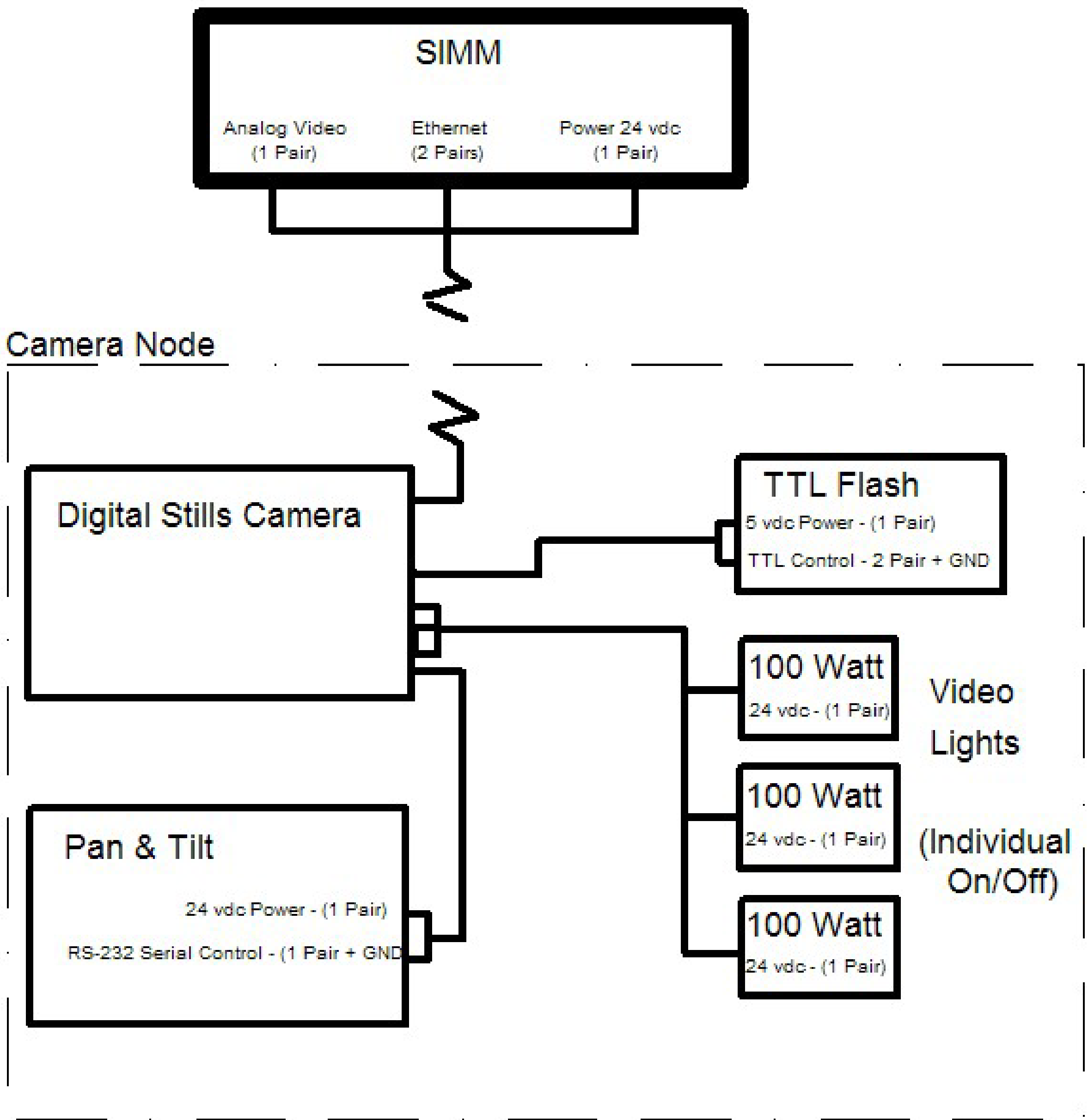
The primary components of the control unit are:

- 24 vdc Input / 5 vdc Output DC/DC power supply (provides source power for camera, USB, and electronic flash).
- Proprietary Ethernet to USB translator board. Provides transparent Ethernet link to 5 port USB hub.

- USB controlled relay card (4 x 14 amp "normally open" relays) – Provides video light switching.
- USB/RS232 converter – Provides RS232 comms for Pan & Tilt unit

*Please note that 2 "spare" USB connections are available at the hub for potential customer use.

Interconnection Diagram



Underwater Connectors

Unless otherwise specified by the customer, all connections to the camera and electronic flash will be SubConn subminiature series, right angle, wet mateable connectors.

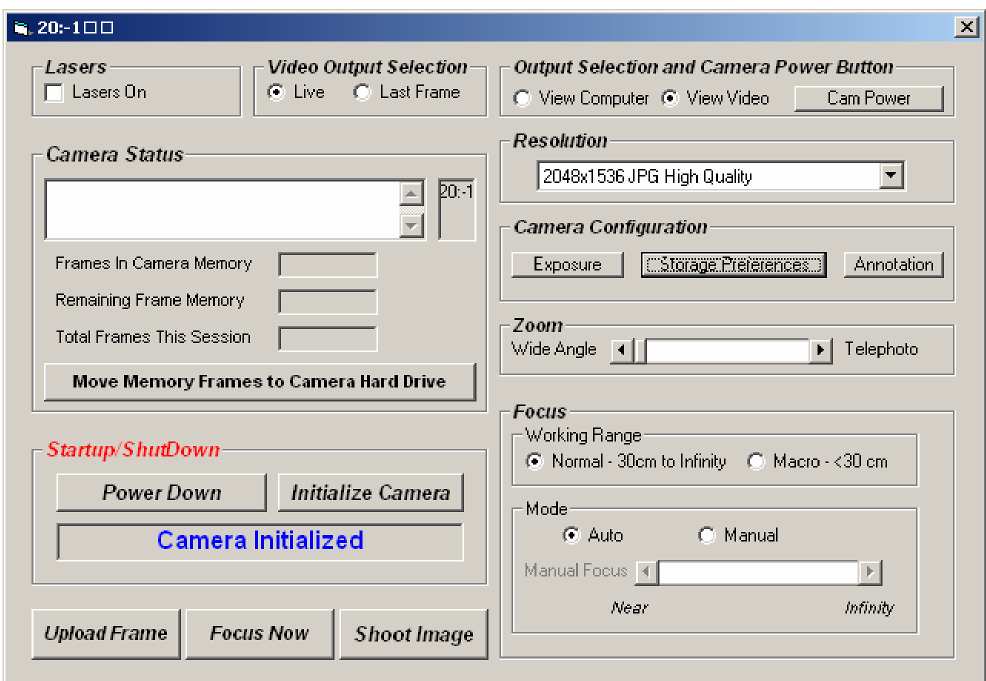
Power Load (Estimated)

Camera, Pan & Tilt, Electronic Flash (at 24 vdc supply) 2.5 amp max, 1 amp average. Peak load occurs at electronic flash "re-cycle".

Video lights add an additional 4 amps continuous load per lamp (100W) when illuminated. Simultaneous use of all three lamps will produce a load of approximately 12 amps.

Topside Control Package

The Cyclops package is controlled topside via a "WindowsXP" computer program. Controls are integrated into C-Map Systems "VideoRuler7DVD" software package. In addition to providing full control of all digital still camera features, VideoRuler also provides live video viewing and DVD compliant MPEG2 video recording, image feature measuring tools, image processing, descriptive database for images and associated information (Access DB format).



Features Include:

Camera, Laser and Processor Control

- All camera control functions available on control panel, including exposure mode, resolution, zoom, flash, auto and manual shutter/aperture
- Processor and image transfer functions controlled from topside panel
- Laser (optional) On/Off control on panel

Merge

- Images automatically merged into VideoRuler database after downloading

Micrometer

- Precision measuring tools for video and hi-res images

Annotation

- Image text annotation available for Time, Date, Positional Coordinates and User text
- Font, text size, text color and position on image user selectable

MPEG2 Recording

- DVD compliant MPEG2 video recording of video from Cyclops or any other PAL/NTSC source

Pricing

Package price includes the following items:

- Cyclops Digital Stills Camera/Controller (300m depth rating)
- Cyclops GN50 Electronic Flash (300m depth rating)
- Sidus SS109 , Oil Filled Pan and Tilt (3000m depth rating)
- Camera and Flash mounting yoke
- Qty 3, Deep Sea Power and Light “RiteLite”, 100w Video Lights (1000m depth rating)
- Interconnecting Cables
- Topside “VideoRuler7DVD” Camera Control Software Package

Theme 5 Engineering and Computational Research

Observing System 1: Coming later