

Preliminary Ideas on In Situ Testing of Optical Properties
of the SPS.

by
A. Roberts, Hawaii DUMAND Center

1. INTRODUCTION

This paper is a preliminary survey of the requirements for in situ optical testing of the DUMAND module, and of its optical environment. It proposes to provide essentially continuous checking of the PMT performance, the sphere transparency and the ocean optical attenuation. Its purpose is to stimulate thought and discussion on a subject on which very little has been written, and which will have a major effect on module and string controller design.

It is assumed that a separate testing mode exists, into which the module may be switched by external command, which can be either a clock-driven interrupt or a shore signal. In this mode, data collection is suspended, test devices are turned on, and the results of the corresponding device tests recorded and transmitted to shore. Further action may be initiated as a result of the tests.

2. OPTICAL TESTS

The optical tests that need to be performed at fixed intervals include:

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2. OPTICAL TESTS

The optical tests that need to be performed at fixed intervals include:

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1. Measurement of PMT gain and sensitivity.

2. Measurement of the transparency of the PMT envelope (hard-hat plus sphere). This is a monitor for sedimentation and biofouling.

3. Measurement of water transparency.

1. Measurement of PMT Gain and Sensitivity.

This is the most straightforward task. It can be accomplished internally within each module. It requires only a fixed, stable optical pulser - presumably an LED - permanently located on the underside of the PMT. The test mode will activate the light pulser at the desired level and record the PMT response.

In view of the strong possibility of intense external illumination of the PMT's by bioluminescent biota, it will be advisable to have several different light levels available, so that tests can be carried out at a voltage sufficiently low to suppress the external signals. Such variation also allows a gain curve to be traced out. The light levels should differ by a factor of the order 10-30. It must be left to experiment to determine whether several different LED's are required, with individual pulsers, or if a smaller number with different pulse levels will do. Light pulsers whose output is accurately determined by the driving pulse are required. Their properties must remain constant over a sufficiently long period of time. It will probably be desirable to provide spares.

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2.Measurement of Sphere Transparency.

This measurement is straightforward, but not trivial. It requires a light pulser outside the surface to be tested. The light pulser cannot simply be mounted directly on the surface under test; that would protect the surface beneath it. It must be spaced away from the sphere; thus to supply it requires a cable from the sphere, and therefore a sphere penetration - which may possibly be shared with another cable, e.g the power cable. It must also be very firmly mounted in relation to the sphere. The problem is thus very largely a mechanical engineering one.

It would be convenient to place the light pulser in an adjacent module; the test would then include the surfaces of both spheres and the water between, which is not as satisfactory as a direct test of a single interface. It will also be necessary to insure somehow that the surface of the light pulser is not itself a source of error, due to sedimentation or biofouling.

Measures to maintain sphere transparency are possible, such as passing a current through a transparent conducting coating. It would certainly be desirable to provide some - not all - surfaces with protection of this or other varieties, in order to check the need for them and their efficacy.

3.Measurement of Water Transparency.

This is the most difficult monitoring task. It requires, optimally, a moderately strong source, and measurements of its intensity at several different distances, preferably with the same detector. In the full-scale DUMAND a

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special installation for this purpose -- perhaps several -- will be required.

In Stage 1, the SPS, we will probably have to settle for monitoring of transmission over a fixed path, taking pains to assure constant or known detector sensitivity, and assuring the absence of sedimentation or biofouling on the detector surface.

A simple and possibly adequate system might include a source at one end of the string and a detector at the other end (i.e., about 50-100m apart.) If the source were at the bottom end, and the detector at the top end facing down, that would minimize the risk of sedimentation on the detector surface; but it would still have to be tested for biofouling. The source and detector must be so located that they have a clear uninterrupted path; thus putting both of them in the detector modules is probably unsatisfactory, unless the modules are adjacent. Outriggers may be required, an unpleasant thought.

The use of adjacent modules to house source and detector is not really satisfactory for detector modules, which are too close together. However, there is no reason why the instrumentation module must be directly adjacent to the detector string. If it is separated along the string by, say, 50 meters, the pulsed light source could be located in, or just outside, the topmost detector module, and the detector PMT, facing downward, inside the instrumentation module.

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