PUBLIC POWER CORPORATION
ATHENS, GREECE

COMMENTS ON MITSUBISHI`S PROPOSED BRINE TREATMENT SYSTEM FOR MILOS GEOTHERMAL POWER PLANT

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NATIONAL ENERGY AUTHORITY

VIRKIR CONSULTING GROUP LTD.

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Your date

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1. INTRODUCTION.

Mitsubishi Heavy Industries, Ltd. (MHI) the contractor for the Milos Island Geothermal Power Project, has recently submitted to Public Power Corporation (PPC) a report titled "Brine Treatment System for Public Power Corporation Greece Milos Island P/P". The document no. PG-TI-3 is dated 6th Feb. 1985.

In accordance with the contract for consultancy services between PPC and Virkir/NEA covering brine studies, brine treatment and reinjection, the following report is submitted. The report deals with the treatment process selected by MHI for use on Milos. The selection of a brine treatment system is the responsibility of MHI but subject to approval by PPC according to the contract between the two parties. MHI is moreover responsible for the successful operation of such a system.

This report presents the opinion of Virkir/NEA on the MHI selection of a magnetohydrodynamic system for use on Milos. It is shown that this system has to date not demonstrated it`s usefulness in solving silica scaling problems in geothermal installations. Lacking proof of the usefulness of the magnetohydrodynamic unit in question Virkir/NEA recommends that PPC should not approve the use of this unit for the power plant at Milos.

2. SILICA SCALING.

Results of the 12 day long production test that was carried out by MHI in December 1984, and witnessed by Virkir/NEA gave different results from those reported earlier by PPC. The silica concentration was shown to be in the range 700-800 ppm, but not 400 ppm as reported in the PPC-MHI contract. The low silica value of 400 ppm was used by MHI for the first design proposal. The design condition for separator and turbine inlet pressure was 8 bars abs., in order to avoid silica precipitation. This has apparently not been changed by MHI, in spite of the higher silica values now experienced (ref 1., p 10). Theory indicates scaling should occur below 20 bars, based on the new silica values. Virkir/NEA inserted a coupon into the 8 bar section of the flowline during the flow test in December. Deposition of silica was observed, and its thickness was 1-2 mm after seven days, corresponding to 50 - 100 mm/year scaling rate.

Considering the above it is clear that the silica scaling problem is more severe than the earlier results would indicate. The design pressure for the steam separator and wellhead should therefore be reexamined. The scaling problem becomes greater in the brine pipes and reinjection wells, as the temperature can be expected to fall below the saturation limit. The only way to overcome the scaling problems in the brine piping and reinjection equipment is appropriate brine treatment.

Virkir/NEA has recommended to PPC the need for detailed brine studies to be carried out as soon as possible in order to investigate possible brine treatment processes and to use the results in the design of the Milos power plant. This approach is moreover called for in the MHI contract, but sofar no serious work has been undertaken. In a reply of Mr. W.A. J. Mahon of Geospac, a subcontractor of MHI, when questioned on this at an Athens meeting held before the production test, he said that they did not condsider it necessary to carry out studies of this nature at Milos, and that they would use their experience gained in other geothermal areas to select the best technology for the brine treatment.

During the flowtest in December Dr. Halldór Ármannsson of Virkir/NEA carried out some brine studies to collect backgroud data. These tests were outside the scope of our contract, but were made at the express request of PPC made during the flow test. The tests gave some interesting results, but they were limited due to lack of equipment and time. The results obtained by the consultant, are described in the the consultants` final report from the flow test in December.

At the request of PPC a telex was sent to PPC prior to the output test in December outlinig the bench scale tests

which Virkir/NEA recommended MHI or PPC to carry out during the production test in December. Nothig came of these suggestions.

Virkir/NEA would like to repeat an earlier recommendation made to PPC in November, 1984, that PPC should demand that MHI persue the brine tests called for in the contract between the two parties. PPC should moreover not agree to any brine treatment system, until tests have demonstrated the effectiveness of the treatment process in question. PPC should also make it clear to MHI that the latest test results shall be used for the design condition, and that the higher figures now obtained for silica, well temperature, and enthalpy do not make the guarantee clauses in the PPC-MHI contract void.

3. MAGNETIC WATER TREATMENT.

MHI has recently submitted to PPC document no PG-TI-3, dated 6th Feb. 1985, titled "Brine Treatment System for Public Power Corporation Greece Milos Island Geothermal P/P". The document is devoted to the description of a magnetohydrodynamic (MHD) system, for the treatment of geothermal fluids. Judging from the "Flow chart of brine treatment", shown in chapter 3, a magnetic device is to be installed in the brine pipeline in front of a settling tank. No further details are given of the proposed brine treatment system at Milos or tests to be carried out to test this treatment process. Several technical reports on magnetic water treatment are included in the document, and also information supplied by the manufacturer of the magnetic device.

To our best knowledge the MHD-system has not to date shown any positive results in treating silica rich geothermal fluids. Tests made by NEA some years ago at Námafljall in Iceland in using a magnetohydrodynamic device in a small district heating system where silica scaling is a problem, showed no improvement. This is furthermore inconsitent with the table on page 39 of the MHI document which lists the installation at Namafjall as an "actual installation". The unit was removed from service and returned to the manufacturer after it was found to be ineffective.

Chapter 4-2 of the MHI document is devoted to the "Test Report of East Mesa Geothermal Power Plant". On page 32 it states that "The Hydrodynamics unit was officially approved by the Department of Energy of the United States Government". This statement was not substantiated by our independent checking in the United States. It was further revealed that the East Mesa site which has a total dissolved solids concentration (TDS) of 20,000-30,000 ppm suffers from calcite scaling problems, and not silica

scaling problems. The TDS for Milos is five times this figure, and calcite scaling is not expected in surface equipment.

Magnetic water treatment by use of "magnetohydrodynamic" devices has been in use in the Soviet Union for some time, but has only been of interest elsewhere for the past ten years or so. It has found applications in producing non adherent scales of sulphates, phosphates and carbonates, and several manufacturers of such devices are in Norway, England, and the U.S.A. A recent reply of an English manufacturer (Hydrodynamic Descalers Limited) was, when asked about the effectiveness of the device: "We are confident of dealing with the calcium carbonate scale but before dealing with silica bearing scale would first request an analysis because it has been our experience that pure silica could be a problem."

Chapter 4-1 of the MHI document gives the preliminary results of experiments currently under way at the Onuma geothermal power plant in Japan. Magnetic water treatment is being tested on geothermal fluids containing 400 ppm silica. The report indicates that the scale becomes non adherent, but states also "However, at this stage, not the one hundred percent of confidence was obtained."

One important factor to consider is that the magnetohydrodynamic device is in any case only capable of affecting the deposition mechanism of the particles formed. The particles have to be removed from the brine in order to render it harmless for injection into wells. And that brings us back to the brine treatment system as a whole.