GE Nuclear Energy

175 Curtner Avenue
San Jose, CA 95125

April 29, 1994

PANTHERS-PCC

Readiness Assessment Report

Assessment Team

T.R. McIntyre	GE-NE (Assessment Team Leader)
P.F. Billig	GE-NE
T.L. Cook	DOE
R.E. Camp	Contractor for DOE
V. Cavicchia	ENEL SpA representing EPRI

Approved: R M' Intyre

T.R. McIntyre
Project Manager, SBWR Test & Analysis
GE Nuclear Energy

EXECUTIVE SUMMARY

On April 12-14, 1994, a team from GE, DOE and EPRI conducted a readiness assessment for the PANTHERS-PCC test program at SIET. The purpose of the assessment was to assure the technical adequacy of the facility and personnel to conduct the upcoming tests in accordance with the test requirements. A specific goal was to ensure that all preparations are either complete or proceeding so that testing may be initiated with high confidence that quality results will be obtained.

The assessment covered a broad area and was subdivided into eleven subjects. These subjects were: (1) Quality Assurance, (2) Facility Assessment, (3) Instrumentation and Data Acquisition System, (4) Data Reduction, (5) Test Plan & Procedures, (6) Control System, (7) Shakedown Tests, (8) Personnel, (9) Pre-test Analyses, (10) Test Schedule, and (11) Occupational Safety and Health.

The Assessment Team concluded that personnel scheduled to perform the upcoming PANTHERS-PCC tests are technically capable to conduct the tests according to established requirements. Procedures and associated quality assurance practices are in place and adequate to control the work. While the facility is not complete, the remaining work is identified and followed by project and test program management. This work is expected to be successfully completed to facilitate the scheduled tests in conformance with test requirements.

The Assessment Team also provided several recommendations which would improve the quality of documentation supporting the tests. These recommendations are presented throughout the report and are given in capital letters for ease of identification.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Background

As part of the Simplified Boiling Water Reactor (SBWR) design process, full-size prototype heat exchangers for the Passive Containment Cooling System (PCCS) and the Isolation Condenser System (ICS) will be tested by SIET and ENEA at the Performance ANalysis and Testing of HEat Removal Systems (PANTHERS) Test Facility in Piacenza, Italy. The Passive Containment Cooler (PCC) and Isolation Condenser (IC) were designed by Ansaldo SpA. The component procurement is the responsibility of ENEL. Ansaldo Componenti has constructed and delivered the PCC to SIET and is currently fabricating the IC.

The objectives and requirements for the PANTHERS program are presented in the PANTHERS Test Requirements & Test Specification (GE document 23A6999, Rev. 1).

PANTHERS-PCC is the designation of the program applicable to the testing of the PCC prototype.

An informal assessment was conducted at SIET in November 1993. Topics in that assessment are repeated here for completeness.

1.2 Purpose

The assessment was conducted on April 12-14, 1994 at the SIET office in Piacenza (Via Nino Bixio, 27). The purpose of this readiness assessment was to assure the technical adequacy of the facility and personnel to conduct the upcoming PANTHERS-PCC tests in accordance with the test requirements. The specific goal was to ensure that all preparations are either complete or proceeding so that testing may be initiated with high confidence that quality results will be obtained.

The PANTHERS-IC Test Program was outside the scope of this review except where components of that program will be used in PANTHERS-PCC (e.g., IC Pool).

1.3 Assessment Team

The readiness assessment was conducted by a team of engineers from GE, the U.S. Department of Energy (DOE), and the Electric Power Research Institute (EPRI), as identified on the cover to this report. In addition, T.M. Lee from the U.S. Nuclear Regulatory Commission (NRC) staff served as an observer.

1.4 Methodology

The readiness assessment was carried out by review of facility documents, observation of the physical conditions of the test loop, and interviews with facility personnel, (see Section 2.0 for detailed workscope).

The assessment was divided into horizontal and vertical reviews. The horizontal review consisted of determining the overall readiness of the facility, its personnel, and documentation. The vertical reviews examined part of the facility in more detail (e.g., a single instrument line, data calculation, etc.) to verify the technical adequacy and correctness of the work.

The Assessment Team split into two working groups for portions of the assessment. T.R. McIntyre and T.L. Cook performed the assessments described in Sections 2.1, 2.5, 2.6, and 2.8. P.F. Billig, R.E. Camp, and V. Cavicchia performed the assessments for Sections 2.2, 2.3, and 2.4. All other sections were assessed by the committee as a whole.

1.5 Assessment Support

The following people provided major support to the assessment:

- ENEA

  P. Masoni - PANTHERS Responsible Test Engineer
  R. Martinelli - SBWR Project Manager
  G. Bianchini - PANTHERS TRACG Analyst

- SIET

  C. Medich - Director Nuclear Area
  G. Cattadori - Assistant to the Director
  A. Musa - Quality Assurance Manager
  S. Botti - PANTHERS Project Manager
  R. Silverii - PANTHERS Instrumentation
  A. Achilli - Experience Manager
  Other SIET personnel were present on a part-time basis and provided support.

- GE

  J.R. Fitch - SBWR TRACG Analyst
  S. Kanobelj - GETSCo-Genoa

2.0 SPECIFIC REVIEWS PERFORMED

2.1 Quality Assurance

a. Quality Assurance (QA) Plan and Conformance with the Plan

SIET is accredited as a nuclear laboratory by SINAL, a consortium of Italian laboratories who have established joint quality assurance (QA) standards. A copy of the accreditation certificate is included as Attachment A.

The SIET QA Plan, Document 00001-QQ, Rev. 2, and Procedures 00002-PP (Document Control), 00003-PP (Instrumentation Control), 00006-PP (Quality Assurance Procedure), 00008-PP (Instrumentation Interface), and 00096-ED (Project Document List) were reviewed as part of this assessment. All were consistent and under revision control with changes to the text noted by bars in the margins with adjacent revision numbers.

It was determined that the QA Plan was (1) approved by GE (letter, May 1993 from D.A. Kaye) and (2) confirmed to be applied satisfactorily by a GE QA audit in September 1993. The QA Plan is in substantial accordance with International Standard ISO 9001, and European Standards ENI-EN-45.001, ISO 49, and UNI 70.002. This latter standard is no longer in use, and will be deleted from the references at the next revision of the QA Plan. The QA Plan is likewise in substantial conformance with Standard NQA-1.

The SIET QA philosophy is to effectively control quality in four main areas: Documentation, Instrumentation, Organization, and Test Operations (see detailed descriptions below):

- **Documentation**

  Document 00096-ED, Rev. 3 was reviewed. This document lists all project documents by revision, originator, checker, and approver, as well as the requirements for external review, approval, and distribution. Dates of document issue or required issue date are also included.

  The procedure for review and issue of documents (Procedure 00002-QQ) was reviewed. Copies of verifier comments and resolution are required to be filed in the Design Record File (DRF). In a later review, this process was confirmed to be performed according to the procedure (Section 2.5d). NOTE: Final approval, including authority by approver to reject comments, is granted to the approver by the QA Plan.

- **Instrumentation**

  Instrument control is codified in Procedures 00003-PP and 00008-PP. During the November 1993 GE/DOE assessment, it was recommended that additional verification signatures be added to instrumentation calibration sheets, as well as other appropriate QA records. Several examples of this actually occurring were reviewed by the Assessment Team, but a requirement has not, as yet, been added to the Instrumentation Control procedures.

  OPEN ITEM: A REQUIREMENT FOR INDEPENDENT VERIFICATION OF ALL DOCUMENTATION THAT CAN EFFECT A NUMERICAL TEST RESULT SHOULD BE ADDED TO APPROPRIATE PROCEDURES.

- **Organization**

  The Assessment Team reviewed the organization chart and personnel records supporting qualification of assigned personnel. Qualification records for two incumbents were checked and confirmed to meet minimum job requirements. The organization chart was up-to-date. Additional comments may be found in the Personnel assessment (Section 2.8).

- **Test Operation**

  The technical and QA pre- and post-test check lists were reviewed. Specific observations are noted in Section 2.5b.

b. *Procedure for Incorporating Changes from the QA Manual into Lower Tier QA Documents*

The Assessment Team reviewed the procedure for how a change to the QA Plan was incorporated into lower tier documents. The method was determined to be consistently and well applied. It is the responsibility of the QA organization, and specifically the SIET QA Manager, to assure that documentation is consistent. However, no formal procedure exists.

RECOMMENDATION: SINCE NO PROCEDURE EXISTS, AND THE QA MANAGER IS RESPONSIBLE FOR THIS ACTIVITY, THIS RESPONSIBILITY SHOULD BE SPECIFICALLY ADDED TO THE JOB RESPONSIBILITIES OF THE QA MANAGER IN PROCEDURE 00006-PP.

c. *Procedure to Assure Consistency Between Information that Can be Found in More Than One Document (e.g., instrument lists)*

As noted in the preceding paragraph, it is the responsibility of the SIET QA Manager to assure that documents are consistent. During the

November assessment, a programmatic weakness in the assurance of consistency between documents was identified. In response to this, the PANTHERS Document Plan 00096-ED-91, Rev. 3 (March 25, 1994) has directed the organization to eliminate duplication of technical information between documents (to the maximum extent possible). This elimination is to be performed at the next revision of each document. Where duplication of information is necessary (e.g., P&ID and Instrument Lists), it is the responsibility of the using engineer to be aware of the duplication and assure consistency when changes are made. Additionally, where appropriate, exact word-for-word duplication is to be used, with an appropriate reference. This latter requirement was verified to be occurring in the consistency between the QA Plan and the Test Plan & Procedures (Section 2.5b).

d. Procedure for Verification of QA Documents

Verification requirements are codified in document control Procedure 00002-QQ. Assessment results are documented in Section 2.5a. No open items were identified.

2.2 Facility Assessment

a. Facility As-built Documentation Including Fabrication Drawings (as available)

The status of all of the PANTHERS-PCC documents being prepared by SIET is given in the PANTHERS Document Plan 00096-ED-91, Rev. 3 (March 25, 1994). The scope of this document was described in Section 2.1a. The PANTHERS-PCC Test Plan & Procedures (TP&P) is scheduled to be revised on May 31, 1994. This is in accordance to the commitment to re-issue the TP&P just prior to matrix testing after all of the shakedown testing has been completed.

The Document Plan lists which documents require approval by ENEA (e.g., Test Plan, Quality Assurance Plan, etc.). For those documents, the ENEA Responsible Test Engineer shows his approval by letter to SIET and stamp & signature on the document. Evidence of this practice was found.

The latest PANTHERS-PCC P&ID was reviewed (SIET Document 00209-DD-93, Rev. 2, March 28, 1994). Evidence of sign-off by the preparer and checker was found. The issue date was in agreement with the Document Plan.

While no as-built piping isometrics were available during the review, as-designed piping isometrics were available. All of these drawings had been issued as general design drawings and were in the process of being checked against the facility prior to re-issue as as-builts. They had been

issued earlier in order to support the pre-test analyses and are scheduled in the Document Plan to be revised by April 30.

Section 2.2d provides a detailed review of one of the piping isometrics.

The large tanks (condensate, vent, etc.) were constructed by an outside contractor and as-built drawings were available. The drawings are stamped by SIET, given a document number, and listed in the Document Plan. Evidence was found of review by SIET with two signatures. Small discrepancies were documented on one drawing (Pool Supports) and the master was retained by the SIET responsible manager. The differences were not considered significant enough by SIET to impact the tests; however, the basis for determining whether a discrepancy is significant was not specified. If large differences should be found, the drawings would be returned to the vendor for correction. Therefore, it is not clear how the deviations of information on vendor documents from the as-built condition are consistently recorded.

RECOMMENDATION: SIET SHOULD MAINTAIN A MASTER VENDOR DRAWING FILE THAT CAN BE USED TO COLLECT AND RECORD SUCH DEVIATIONS. THE MASTER VENDOR DRAWINGS SHOULD BE RETAINED AS PART OF THE DESIGN RECORD FILE. THIS WILL AVOID QUESTIONS ON THE "AS-TESTED CONFIGURATION".

b. Status and Procedures to Finalize Documentation for Unavailable or Incomplete Documents

The piping isometric drawings need to be reissued to document the as-built dimensions. All of these revisions are scheduled for April 30, as given in the Document Plan. The SIET PANTHERS Project Manager is in the process of reviewing the drawings against the completed piping.

c. Physical Condition of the Test Facility

After a tour of the facility, excluding the control room and DAS, the Assessment Team concluded that it is near ready for testing. All of the piping is in place and insulated. Most of the instruments are installed, tubed to the measurement points (if applicable), and connected to DAS cabling. In general, only the cabling for the instruments that had been used during shakedown tests were verified (Section 2.3e). The major remaining work is to install the pool instrumentation, connect the pool and PCC instrumentation and close the pool.

d. Vertical Review: Compliance of As-built Piping Drawings

The Assessment Team confirmed the compliance of as-built piping drawings for key systems by tracking the line for one system through the facility. The drain lines from the PCC to the condensate tank were

chosen for the vertical review. The piping isometric (Drawing 24.02.13, Rev. 1, December 13, 1993) was compared against the PANTHERS-PCC P&ID. All of the instrument and valve labels and pipe sizes agreed.

The Assessment Team walked through the piping, instrumentation and valving on the facility and compared it against the isometric drawing. All instrumentation lines were labeled with the SIET instrument number, PANTHERS-PCC test instrument number and the date of last calibration. One thermocouple was chosen at random for a more detailed review. The instrument chosen was SIET No. TCK 38 or PANTHERS No. T5001 and is located below the tee junction on the PCC drain line. The date of last calibration was April 19, 1993. It was connected to DAS line # 22. A check of the calibration records at the instrumentation laboratory showed agreement with the instrument numbers and calibration date. While the instrument list did not identify when the instrument was due for calibration, all test instruments require re-calibration after one year. Therefore, it is readily apparent when re-calibration is due. The specific instrument calibration sheet in the calibration shop for each instrument does give the calibration due date. The manager of the instrument shop told the Team that he reviews the calibration records about once a week and at least each month to see which instrument will soon require calibration. In addition, the Test Procedures include a step in the pre-test checklist to check that all instruments are calibrated. The Team feels that these two independent checks will ensure that no tests are run with instruments out of calibration. NOTE: one exception to this rule exists – the thermocouples, which have been brazed on the PCC tubes, cannot be removed for shop calibration. This information may be validated during test performance by comparisons to nearby measurements, and the Team finds this to be acceptable.

Most of the instrumentation on the drain line were pressure taps for the delta-P measurements. Each of the taps had labels designating which delta-P instruments used the tap, as well as an indicator of "+" or "-" for whether that instrument used the tap for an upper (+) or lower (-) delta-P input. All of the labels were in agreement with the isometric.

While the isometric reviewed was not a final as-built, the Team did review it for accuracy to the installed as-built condition. As stated above, SIET plans to reissue the isometric at the end of April following a check against the actual facility. The Team did find the following discrepancies and incompletions which will need to be incorporated during the revision:

- The pressure tap below the tee junction is given as the distance from the exterior of the horizontal pipe of the junction. The figure does not indicate what the diameter of that pipe is, although SIET identified it as 6 inches. Because of the presence of the insulation, the Team recommends that the instrument location should be

referenced to the centerline of the pipe and a note added that the tee shown is 6 inches on all sides.

- Vent and drain lines and valves F507 & F508 are shown on the drawing but are not installed and, therefore, should be deleted from the drawing.

- Thermocouple T5002 is not located where shown on the drawing.

- The vertical leg below the tee junction has small bends not shown on the drawing.

To increase precision on the delta-P tap locations, SIET measured their elevations by marking a column away from the test setup at the same elevations as the taps. This was done by using clear hose filled with water up to the tap elevation with one end at the tap and the other end at the column. The difference in elevations of the marks then corresponds to the delta-P tap elevations. The Assessment Team examined both the column and the log of the measurements. There were three signatures on the log. When an elevation differed between the design value and measured value, the measured value was incorporated in the drawing.

A spot check was performed for one instrument location (DP019 top) and was in agreement with the drawing.

e. Release and Control of Design Information for Procurement

Procurement specifications for the major components (i.e., vent tank, condensate tank, etc.) were reviewed. These specifications were prepared by SIET prior to ordering and contained all of the necessary information for the vendor.

f. Procurement Specifications

A representative procurement specification for one of the tanks was reviewed in detail. It listed all design requirements and included a sketch of the tank showing location of supports and nozzles.

g. Compliance to Controls on Facility Documentation

The key facility documents showed signatures by the preparer, checker, and the SIET Director Nuclear Area. As instructed by the QA Plan, the director decides who will be responsible for checking each document.

h. Adequacy of Verification on Facility Documentation

The multiple signatures demonstrates adequacy of verification (see Section 2.3g).

i. Procedures (where applicable) for Turning Over the PCC from Ansaldo Componenti (ACO) to SIET

There are no formal turnover procedures for SIET to receive the test unit. The four-party agreement among GE, Ansaldo, ENEA and ENEL describes the responsibilities for each participant. ENEL funds ACO to build the PCC, which is then given to ENEA for testing at SIET. The final task for ENEL/ACO was the hydro-test at SIET after installation. Even though SIET conducted the test, the responsibility rested with ACO. After the successful completion of the hydro-test, ENEL accepted the component, and ENEA/SIET accepted the delivery of the unit. SIET had copies of the as-built drawings of the PCC from ACO, but there was no evidence of a formal transfer of the unit.

RECOMMENDATION: A FORMAL TRANSFER OF THE PCC FROM ACO/ENEL TO ENEA/SIET SHOULD BE DOCUMENTED.

j. Status and Adequacy of Spare Parts On Site or Deliverable Times

See Section 2.3g.

k. Evidence of Permanent Labels on Facility Components (e.g., valves) and Applicable Instruments (e.g., pressure transducers)

Key facility components, such as valves and spectacle flanges, had metal tags attached giving the part number specified by the PANTHERS-PCC P&ID. The instrument lines had tags giving the facility instrument number, the test instrument number (on P&ID), and the date of last calibration.

2.3 Instrumentation and Data Acquisition System

a. Calibration Procedures

All of the PCC instruments are calibrated by SIET at their calibration laboratory on site. The procedures used conform to industry standards. Primary standards are traceable to the Italian equivalent of the U.S. National Bureau of Standards.

b. Compliance to Controls on Calibration

SIET has been certified to calibrate the instruments. Calibration documents are kept in the calibration laboratory.

c. *Adequacy of Documentation and Verification on Instrument Installation and Calibration (including assurance that all instruments will be re-calibrated before expiration of the calibration)*

The instrument log in the calibration laboratory records which facility instrument is used in the test by listing the facility instrument number with the PANTHERS-PCC P&ID instrument number. The installed instruments are also identified with both labels. The installation is independently checked and evidence of verification can be found in the instrument lists in the TP&P. Procedures to ensure current calibration are described above in Section 2.2d.

The instrument are not re-calibrated until the calibration expires. There is no requirement to check the calibration of instruments immediately following the testing unless its calibration expires. However, SIET plans to use quick reviews of instrument readings prior to each test to confirm that the instruments are functioning properly.

RECOMMENDATION: SELECTED CRITICAL INSTRUMENTS SHOULD HAVE THEIR CALIBRATION CHECKED AT THE END OF THE TEST PROGRAM TO DEMONSTRATE THAT KEY DATA ARE CORRECT. INSTRUMENTS CHOSEN SHOULD BE THOSE WHOSE PERFORMANCE CANNOT BE EVALUATED BY COMPARISON TO READINGS FROM NEIGHBORING INSTRUMENTS (E.G., DELTA-P ACROSS AN ORIFICE).

d. *Identification of Critical Instruments for Testing*

The Responsible Test engineer from ENEA has identified which instruments are critical for each test series. This identification will be included in the next revision of the TP&P.

e. *Vertical Review: History and Layout of a Specific Instrument*

The Assessment Team traced the history and layout of the drain line thermocouple (T/C) T5001 through the following stages:

- **Procurement**

  The procurement of the PANTHERS instruments is documented in the SIET Technical Report 00159-RF-92. The report gives what instruments were procured, the criteria for the selection, and the purchase specification. The T/C supplier (TERMICS) confirmed in writing that the instrument will satisfy the purchase specification requirements. When the instrument arrived at SIET, it was assigned a facility number (in this case, TCK 38).

- **Calibration**

  Data sheets are maintained for each facility instrument. The sheets for TCK 38 were reviewed and found to be in agreement with the instrument tag as to calibration date.

- **Installation**

  TCK 38 is installed at Location T5001 on the PCC drain line below the tee junction. Cable 22 was used. The cable number agreed with that listed on the instrument sheet.

- **Connection to Control Room**

  According to the instrument sheet, Cable 22 is connected to Pod 5, Channel 8 of the Data Acquisition System (DAS). The Team traced the cable to that location. The signal is then sent to the central processing unit of the DAS at Slot 88, which was shown on the DAS monitor in the control room. While this instrument did check out, the cable work for others is still in progress. When it is complete, all of the cabling will be verified and documented. To date, most instruments that have been checked are those required for the shakedown testing.

- **Field Test**

  This instrument had been checked on March 29, 1994.

- **Data Recording**

  Instrument T5001 was correctly listed on the DAS as coming on Slot 88 from the facility.

f. DAS Validation and Control

In January, SIET decided to use a different DAS than previously chosen. Three personal computers (PCs) are now used in the DAS. One PC records the mechanical instruments, one the thermohydraulic instruments and the third does the data reduction calculations. This system was chosen because (a) it is more accurate and reliable, (b) SIET had previous experience using it during the shakedown tests, and (c) SIET wanted to separate the PANTHERS DAS from the DAS used in other programs.

The equations used to convert the electrical signals to engineering units are given in the TP&P. SIET is currently validating and verifying the DAS software and is scheduled to complete this task at the end of April.

RECOMMENDATION: CALCULATIONS USED FOR VERIFICATION OF COMPUTER CALCULATIONS, CONVERSION CONSTANTS, ETC. SHOULD INCLUDE DOCUMENTATION OF WHO PERFORMED AND WHO CHECKED THE CALCULATION.

g. *Status and Adequacy of Spare Instruments On Site or Deliverable Times*

The availability of spare parts and maximum time for procurement of more has been determined and is documented in the table provided in Attachment B.

2.4 Data Reduction

a. *Documentation and Verification of Software Configuration*

The equations used to convert the test data to other parameters (e.g., flow rates, water levels, etc.) are given in the TP&P. SIET is currently validating and verifying the data reduction software and is scheduled to complete this task at the end of April.

b. *Vertical Review: Software Agreement with the Calculated Parameter*

Since software installation and validation is still in process, the Assessment Team concluded that a review of the procedure was more appropriate. The procedures that SIET will follow to document and verify the software were found to be adequate. After installing the software and checking it, SIET plans to validate the software by sending known parameter values from the data collecting PC to the data reduction PC, recording the PC calculated value, manually calculating what the value should be, and then comparing the manually calculated value to that of the PC. Two checks for each calculated value will be performed. This results in an independent check of the DAS reduction software and satisfies QA requirements. The results of this task will be documented in the DRF.

2.5 Test Plan and Procedures

a. *Adequacy of Test Plan to Satisfy Test Objectives*

The Test Plan and Procedure (TP&P), SIET Document 00089-PP-91, was reviewed against GE Test Specification 23A6999, Rev. 1, to evaluate this objective of the assessment. It was confirmed that the test objectives in the TP&P conform exactly with the objectives in the test specification. The revision level of the TP&P is consistent with that shown in the Project Document list. As noted previously, the TP&P is in the process of being revised to incorporate lessons learned during the shakedown test period. The revision process for the TP&P was reviewed in detail and is described in Section 2.5d.

The TP&P consists of three sections: (1) Test Plan, (2) Test Procedures, and (3) Quality Assurance Requirements. Spot checks of the Test Plan uncovered no discrepancies with the test requirements. Test Procedures are given in the format of checklists to be completed while conducting the tests. In general, these checklists are concise, logical, and complete, and are being updated during the shakedown test process. For recent shakedown tests, the test checklists from the TP&P have not been used, but updated checklists incorporating lessons learned from previous tests have been provided to test personnel. The process is described in detail in Section 2.5d. Assessment of the QA section of the TP&P is given in Section 2.5b.

During review of the TP&P and supporting documentation, three minor discrepancies were noted:

- A discrepancy of 5 mm in a dimension on PCC pool drawing 24-02-63 was found. The test engineer knew the resolution to the situation, but it was not noted on the drawing. This situation is analogous to the situation described in Section 2.2a with regard to vendor drawings. The same recommendation applies here.

- No documentation of the review of the TP&P by GE, as required by the Project Document list, was in evidence. The SIET and GE engineers confirmed that comments were received and incorporated during face-to-face meetings.

- It was the understanding of the Assessment Team that the volume of the prototype SBWR PCC pool had changed "slightly" from the 173 m^3 value given in both the TP&P and Test Specification, but no resolution of the importance of this change to the facility scaling was in evidence.

OBSERVATION: THERE SEEMS TO BE A MINOR WEAKNESS IN DOCUMENTATION OF THE GE/SIET INTERFACE. BOTH SIET AND GE ENGINEERS WERE AWARE OF THE ABOVE ITEMS, BUT DOCUMENTATION OF THEIR RESOLUTION COULD NOT BE FOUND IN THE DRF OR OTHER PROJECT FILES. GE AND SIET SHOULD BE MORE DILIGENT IN DOCUMENTATION OF MINOR ITEMS AND VERBAL AGREEMENTS.

Overall, the TP&P was assessed to be sufficient to meet the test objectives.

b. Compliance of Document with QA Procedures

This item was assessed by review of Section 3 of the TP&P versus the SIET QA Plan 00006-QQ-92. Quality requirements in the TP&P were word-for-word duplicates of the QA Plan, with section-by-section references for assurance of consistence. This process was consistent with that described in Section 2.1c. The QA Plan includes a requirement for a

pre-test QA checklist, and the test specific checklist was included in the TP&P.

Section 7.2 of the QA Plan included a revision (Rev. 2) which was confirmed to be consistent with the TP&P QA requirements, giving further validation that the change control measures described in Section 2.1b are being properly employed.

c. *Evidence of Administrative Controls on Tests*

Administrative controls on testing are assured through the use of a plant test log and checklist test procedures that will be included in the DRF.

- **Plant Log**

  Plant test logs are kept by the test engineer for all facility evolutions. Logs are typewritten, and signed-off by the test operator. A single logbook includes items from all tests and facility activities. Test logs for two different facility activities were reviewed in detail.

  Notes from a test facility characterization activity which calibrated Orifice Plate F2002 were reviewed. The notes were complete and logical. Original calculations were in the DRF.

  Additionally, a DAS verification activity was reviewed. Included in the test log were the date of the evolution, the personnel involved, activity description observations (nothing out-of-the-ordinary, in this case), and a listing of "enclosures", which gave the results of the verification.

  Evidence of verification was included on the enclosure.

  Copies of the test procedure checklists for Shakedown Test C-04 were found in the log (originals were filed in the DRF). Steps were confirmed by dual initials (performer and checker) on the checklists. The technicians identified in the test log as supporting the test were confirmed to have appropriate qualifications on file in the personnel qualification file.

- **Design Record File**

  The DRF section for Shakedown Test C-04 was reviewed. It included a summary report on apparent test conclusions. Data (on 3 1/2 in. floppy disks) were included in the DRF. File information necessary to read the magnetic information was written on each disk, and each disk was signed-off by the test engineer and test director. Originals of the QA Pre-test Checklists were included. Changes to the Test Procedures for this run (see

Section 2.5d) were also included, as was a letter notifying site personnel on the date for the test - a safety item.

RECOMMENDATION: THE DATA DISKS IN THE DRF SHOULD BE WRITE-PROTECTED.

A deviation form was included in this DRF section, since one of the three test objectives for Test C-04 was not met. During the performance of the test, the test director determined a better way to provide the specific level control function being demonstrated. The test was aborted, and a deviation form (analogous to a non-conformance report) prepared. The proposed resolution (accepted) was to run an additional shakedown test (C-04.1), using the modified control procedure and algorithm.

As noted in the previous section, the original test conduct checklists were included in the DRF.

d. Process of Preparation, Review, and Revision of Test Procedures

This area was assessed by review of the original (master) copy of SIET Procedure 00098-PP-91, the Test Plan and Procedure. The file included the original verification cover sheet, with original signatures (in black ink). Both ENEA and SIET original approvals were in evidence.

The document was stored with other original SIET nuclear research documents in a locked cabinet in the separately locked original file room. All originals are logged in and out of the storage area.

The method for incorporation of changes was discussed. During shakedown testing, verified override packages are being prepared and provided to the test performers. This override document forms the basis of the pre-test briefing. Formal evidence of the briefing, including the attendees of the briefing, is included in the DRF.

This procedure is being followed late in the shakedown program due to the number and extent of process improvements identified during the shakedown program to date. While a revision of the TP&P will be produced, incorporating the appropriate changes prior to the start of matrix testing, it has been judged that the effort to do this during the shakedown program is not warranted. The Assessment Team concurs with this position, and judges the process being used to be satisfactory.

The procedure was illustrated by review of documentation from the DRF of Test C-04. This DRF contained a package of checklists, which superseded the checklists in the TP&P. Critical (i.e., "must have for success of the test") instrumentation was identified. Verification of the superseding checklists was included.

The Assessment Team then questioned how it will be assured that all of the changes identified will be included in the TP&P revision. A single, current "red-line" markup of the TP&P does not exist. Instead, each section has a responsible individual, who is responsible for updating his own section. It is the responsibility of the TP&P approver to assure that all individuals have made their own inputs. The approver will then call a meeting to resolve any inconsistencies or issues, and compile a total list of changes. The entire document will then be verified.

The Assessment Team concluded that this process was different than the way they would have proceeded, but finds it to be technically adequate.

e. Identification of Test Prerequisites, Initial Conditions, and Acceptance Criteria

Test prerequisites and initial conditions are codified in the TP&P through the use of checklists. Acceptance criteria for the shakedown testing are typically qualitative (e.g., does the system work) rather than quantitative, and therefore somewhat subjective in nature. As noted in previous sections, in those cases where quantitative output was generated (i.e., facility characterization testing), it was well documented. For example, during the DAS verification testing, the results were compared with the overall linearity requirement of 3% - the acceptance criteria in the Test Specification.

For matrix testing, Chapter 11.1 of the TP&P gives a table of specific acceptable ranges of independent test variables.

RECOMMENDATION: THE TP&P DOES NOT CURRENTLY HAVE A DEFINITION OF REQUIREMENTS THAT DEFINE "STEADY STATE". SUCH A DEFINITION SHOULD BE INCLUDED IN THE TP&P.

RECOMMENDATION: AT THE CONCLUSION OF MATRIX TESTING, THE PLANT LOGS SHOULD BE ADDED TO THE DRF FOR COMPLETENESS.

f. Procedures to Resolve Unexpected Results or Unanticipated Behavior During Testing

As noted in Section 2.5d, the TP&P contains a procedure for response to unexpected results. In this case, a deviation form is prepared. This form is very similar to a nonconformance report, and requires elucidation of the deviation, recommended resolution, and approval or disapproval of the resolution by appropriate management personnel.

2.6 Control System

a. Adequacy to Satisfy Test Procedures

Assessment of control system adequacy was performed by a visit to the plant control room. SIET Drawing 00209-DD-93 (PANTHERS facility P&ID) was reviewed to gain an understanding of critical control parameters and methods. Facility controlled parameters include steam mass inlet flow rate, air mass inlet flow rate, and PCC inlet pressure and temperature (controlled via condensate tank exhaust pressure and desuperheating injection flow rate, respectively). All parameters are controlled from the main control room via digital automatic controllers, and air-operated valves, except for desuperheating flow, which uses manual control from the main control room.

Several facility trim valves are manually controlled in-plant, by radio directed technicians.

All control functions are physically separate from data acquisition functions. Information from the DAS is used for definition of input conditions, not control system data.

At this time, the facility has yet to operate in the steam condensing mode required of matrix testing. Capability of the control system to establish and maintain appropriate steady-state conditions will be confirmed during Shakedown Tests H-04 and H-05, scheduled for late May.

None of the Assessment Team members are experts in control systems; however, their joint technical judgment is that the system approach and hardware installed are rational and should be adequate.

b. Documentation of Verification of Controls

Since the control system is designed only to maintain steady-state conditions, performs no control function that would affect test results, and is totally independent of the DAS, verification of control function is not required for PANTHERS testing.

2.7 Shakedown Tests

a. Results of Conducted Shakedown Tests and Compliance with QA Procedures

After each shakedown test, an apparent test report (ATR) is prepared to determine if the test satisfied the test objectives. The Assessment Team conducted a detailed examination for Test C-04. The Team confirmed that the test was in compliance with the QA requirements. As a result of Test C-04, SIET has decided to use a different procedure to control water level in the condensate tank (see Section 2.5c for details).

As a result of the shakedown tests to date, most of the facility has been tested, excluding the PCC unit. The remaining facility controls to be tested are those to control the pressure in the vent tank. These will be covered during Tests H-04 and H-05.

b. Status of Remaining Shakedown Tests

The remaining shakedown tests are C-03, C-04.1, H-01, H-04, and H-05. The schedule for these are given in Section 2.10.

2.8 Personnel

a. Responsibility Assignments (including backups for key roles)

The PANTHERS Organization Chart was reviewed to familiarize the Assessment Team with the organization and personnel assignments. The organization chart was up-to-date and consistent with actual practice. All positions have incumbents, which were keyed to job responsibilities and minimum qualification requirements.

Critical operations positions have an incumbent, backed up by one other individual having similar skills and training. Management positions are generally backed up with delegation of responsibility and/or authority to the next higher management level.

b. Adequacy of Training or Background to Meet Responsibility Requirements

Several incumbents' records were reviewed and found to be consistent with requirements. Minimum job requirements were spot checked and found to be reasonable for the position descriptions.

2.9 Pre-Test Analyses

a. Status and Schedule for Completing Pre-Test Analyses

The Pre-test Analyses report is scheduled for submittal to the NRC on May 11, 1994. A draft of the report was circulated during the April 12-14 meeting.

b. Adequacy of Controls and Verification

GE performed a one-over-one verification of the ENEA TRACG deck in accordance with GE Engineering Operating Procedure (EOP) 42-6.00, "Independent Design Verification".

GE performed an independent analysis using the PCCS model from one of the base SBWR TRACG decks. This model and the overall text of the pre-test analysis report were reviewed in late April 1994.

2.10 Test Schedule

a. Evidence of Test Schedule and Agreement with SBWR Program Integrated Schedule

The current test schedule was presented at the April 12-14 meeting (Attachment C). It is not in a typical schedule format, as no logical relationships are identified. However, the schedule is referenced to one maintained by GE in San Jose in which logical ties are preserved. Differences between it and the SBWR certification schedule at GE are due to the following:

- SIET has decided to mount the pool instrumentation on a rigid frame rather than wires strung between the walls. The closure of the pool has beer rescheduled to after the instrumentation installation because it is easier to work with the wall down. The earlier method required the pool to be closed prior to instrument installation. The combined time to install the instrument and close the pool remains the same, so this change does not impact the test schedule.

- As described above, part of Test C-04 will be repeated as Test C-04.1. The schedule shows this as occurring on April 12-13, but it has been delayed three weeks in order to support the readiness assessment and complete the analysis of Test C-04. It is not on critical path.

While the presented schedule does not indicate interrelationships, those relationships are documented by ENEA. After the assessment, ENEA noted that the Task List (Attachment C) was derived from a program (MACPROJECT II) which can present schedules in different formats. However, the program needs, as input, the identification of all the tasks, with their duration and the logic relationships with the other tasks.

b. Detailed Action Plan to Track Critical Path and Maintain Schedule

SIET maintains a detailed Action Plan which lists all remaining tasks to be completed prior to matrix testing along with their expected dates. The plan is periodically updated and the date of the last update is indicated. The list is used by appropriate plant personnel and the SIET project manager tracks progress. The Assessment Team reviewed the list and, by spot checking, found it to be consistent with the test schedule.

2.11 Occupational Safety and Health

a. Evidence of Facility Safety Plan

There is no written facility safety plan. A full-time facility safety engineer is on site and is responsible for conducting annual training, interfacing with regulatory bodies, conducting briefings on specific hazards as needed, and maintaining records pertaining to facility and personnel safety.

b. Safety Training Requirements

There is annual training for all personnel and there are written procedures used in specific hazardous environments and for certain protective equipment (i.e., electrical switching equipment and fire protection equipment). Briefings are held to discuss specific hazards such as working in a plant with live steam.

c. Compliance with SIET Safety Plan and Italian Statutes

Outside safety experts were retained to train the SIET Safety Engineer. An assessment was made to ensure compliance with Italian regulations. Authorities were notified of high levels of PCB's in site transformers and of potential asbestos problems. These authorities have conducted their inspections and implemented appropriate measures.

Evidence of compliance with the SIET Safety Plan was demonstrated by the workers using hard hats while on the shop floor. In addition, all visitors were issued hard hats when touring the facility.

3.0 CONCLUSION

3.1 General Assessment

The readiness Assessment Team has concluded that personnel scheduled to be involved in performance of the upcoming PANTHERS-PCC tests are technically capable to conduct the tests in accordance with the test requirements. Procedures and associated quality assurance practices are in place and adequate to control the work. The facility is not complete; however, remaining work is identified and followed by project and test program management. The Team concludes that the remaining work can be reasonably expected to be completed as required to perform the tests as currently scheduled and in conformance with test requirements.

3.2 Recommendations

The Assessment Team has provided several recommendations in the above sections which will improve the quality of documentation supporting the tests.

ATTACHMENT A

SIET LABORATORY ACCREDITATION CERTIFICATE

SINAL

Sistema Nazionale per l'Accreditamento di Laboratori

CERTIFICATO DI ACCREDITAMENTO

Numero di Accreditamento

0031

Si certifica che

Il Laboratorio SIET

Società Informazioni Esperienze Termoidrauliche

Via N. Bixio 27 - 29100 Piacenza - PC

è accreditato dal SINAL per l'esecuzione delle prove il cui dettaglio è riportato nelle schede che accompagnano questo certificato e che riportano il numero di accreditamento sopra citato. Le schede possono subire variazioni nel corso del tempo.
L'accreditamento comporta la verifica della competenza tecnica del Laboratorio relativamente alle prove accreditate e del suo Sistema Qualità, in conformità alle prescrizioni della norma UNI CEI EN 45001 e dei criteri applicabili delle norme UNI CEI EN serie 29000.
L'accreditamento resta in vigore fino al Febbraio 1996, come previsto dalla convenzione stipulata fra SINAL ed il Laboratorio in oggetto sempre che il Laboratorio conservi la conformità alle prescrizioni del Regolamento Generale e delle regole particolari SINAL applicabili alla fattispecie.

Il Direttore

Il Presidente

SINAL

ACCREDITATION CERTIFICATE

ACCREDITATION NUMBER
0031

It is certified that:

SIET Laboratory

is accredited by SINAL for test performances whose details are reported in the documents enclosed to this certificate which report the acccreditation number above mentioned. These documents can be modified in the course of time.
Accreditation implies the check of Laboratory technical competence in relation to accredited tests and of its Quality Systems, in compliance with prescriptions of UNI CEI EN 45001 standard and of applicable criteria of UNI CEI EN, series 29000, standards.
Accreditation remains in force up to February 1996, as provided by the convention drawn up by SINAL and the involved Laboratory, as far as this Laboratory maintains the compliance with prescriptions of General Regulations and of particular SINAL rules applicable in the case in point.

ATTACHMENT B

PANTHERS-PCC SPARE PARTS

PCCSPARE.XLS

PANTHERS-PCC SPARE PARTS

february 23, 1994

ITEM	SPARES AVAILABLE AT SIET	MAX. TIME REQUIRED FOR PROCUREMENT
PIPING & FITTINGS	SOME	2 WEEKS
VALVES	SOME (SPEC. TO BE VERIFIED)	3 MONTHS
FLOW DEVICES	NONE	1 WEEK
PRESSURE TRANSDUCERS	SOME (SPEC. TO BE VERIFIED)	2 MONTHS
FLUID TEMPERATURE THERMOCOUPLES	16	2 WEEKS
PLATE WALL THERMOCOUPLES	42	2 WEEKS
STRAIN GAGES	3	2 MONTHS
ACCELEROMETERS	1	2 MONTHS
THERMORESISTANCES	57	1 MONTH
LVDTs	1	2 MONTHS
CABLES	SOME	IMMEDIATE
DAS CARDS	NONE	1 MONTH
DAS PC	AVAILABLE	1 WEEK

made by R. Silvestri

ATTACHMENT C

PANTHERS-PCC TEST SCHEDULE

	Activity	Slack	Actual Start	Actual Finish	% Done
Assembling					
	Module delivery	1	7/11/93	8/11/93	100
	modules positioning	1	9/11/93	15/11/93	100
	Bolts verification	1	16/11/93	18/11/93	100
	vent & drain pipe delivery	9	24/11/93	24/11/93	100
	modules lifting up	1	19/11/93	22/11/93	100
	PCC covers delivery	5	23/12/93	23/12/93	100
	Pool Gaskets	1	23/11/93	3/12/93	100
	Riser distributor etc. delivery	-1	3/12/93	23/12/93	100
	Vent/drain pipe welding	3	2/12/93	10/12/93	100
	Modules positioning	3	13/12/93	16/12/93	100
	SIET Welding	4	20/12/93	23/12/93	100
	Riser, distributor, etc welding	0	22/12/93	29/12/93	100
	Closing of the loop	0	30/12/93	30/12/93	100
PCC instr.					
	I001 Welding T/C	40	31/12/93	3/1/94	100
	I003 Gasket delivery	39	15/1/94	15/1/94	100
	I002 Welding S/G	40	4/1/94	11/1/94	100
	I004 Gasket installation	28	1/2/94	1/2/94	100
	PCC cleaning	30	25/1/94	28/1/94	100
	I005 Close Headers	0	14/3/94	21/3/94	100
	I006 PCC instrumented	0	21/3/94	21/3/94	100
Pool instr.					
	P001 Pool Panel Preparetion	1	22/3/94	23/3/94	100
	P003 Install Instr. Frame Structure	1	24/3/94	8/4/94	100
	P004 Install pool sensors	0	12/4/94	21/4/94	0
	P002 Close pool	0	22/4/94	3/5/94	0
	P005 Pool penetration for Pool instr	0	4/5/94	9/5/94	0
	PCC cleaning	0	10/5/94	10/5/94	0
	P006 Finish pool instr	0	10/5/94	10/5/94	0
Shakedown					
	S001 DAS for H02	6	1/11/93	14/12/93	100
	H02 configuration	20	1/11/93	25/11/93	100
	Hydrotest	16	22/3/94	22/3/94	100
	S002 Execution H02	11	8/12/93	21/12/93	100
	S003 DAS for C04	12	21/12/93	29/3/94	100
	Air Filters	15	10/4/94	13/4/94	90
	S005 Complete thermal insulation	78	19/ /94	25/1/94	100
	S004 Execution of C04	12	30/3/94	1/4/94	100

	Activity	Slack	Actual Start	Actual Finish	% Done
	S013 Analysis of H02 results	73	16/12/93	6/1/94	80
	S015 Analysis of C04 results	12	5/4/94	11/4/94	60
	S004 Execution of C04.1	12	12/4/94	13/4/94	0
	S006 DAS for C03	12	14/4/94	18/4/94	0
	S007 C03 execution	12	19/4/94	21/4/94	0
	S008 DAS for H01	-1	11/5/94	11/5/94	0
	S010 Complete DAS	-1	12/5/94	17/5/94	0
	S009 H01 execution	-1	18/5/94	23/5/94	0
	S015 Analysis of C04.1 results	20	14/4/94	20/4/94	0
	S016 Analysis of C03 results	19	22/4/94	28/4/94	0
	S014 Analisys of H01 results	2	24/5/94	30/5/94	0
	S011 H04 execution	-1	24/5/94	27/5/94	0
	S012 H05 execution	-1	30/5/94	2/6/94	0
	S017 Analysis of H04 results	2	31/5/94	6/6/94	0
	S018 Analysis of H05 results	0	3/6/94	8/6/94	0
Testing					
	T001 Test for SBWR certification	0	9/6/94	5/7/94	0
	T002 Start Test report	0	9/6/94	5/7/94	0
	T003 Draft test report	0	6/7/94	2/8/94	0
	T007 Complete PCC tests	0	6/7/94	13/12/94	0
	T004 Review	0	3/8/94	9/8/94	0
	T005 Close open items	0	10/8/94	23/8/94	0
	T006 Issue final report	0	24/8/94	12/9/94	0