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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-5328

DATE:	March 30, 1995
SUBJECT:	Report of Foreign Travel of B. R. Bass, Computational Physics and Engineering Division
TO:	Alvin W. Trivelpiece
FROM:	B. R. Bass
Purpose:	(I) Participate in two meetings on behalf of the international Network for Evaluating Steel Components (NESC): (1) the Evaluation Task Group (TG5) and (2) the Steering Committee of NESC; (II) Participate in meetings of the Organizing Committee of the Project for Fracture Analysis of Large-Scale International Reference Experiments (FALSIRE), concerning the organization and completion of FALSIRE Phase II .

Sites Visited:

3/7-8/95	FALSIRE II Meetings, Gesellschaft für Anlagen- und Reaktorsicherheit (GRS)	Köln,Germany
3/9-10/95	NESC Meetings, GRS	Köln, Germany

Abstract:

The primary purpose of the trip was to participate as the U. S. A. representative in meetings held as part of the international Network for Evaluating Steel Components (NESC) Program. The NESC was organized as an international forum for the exchange of information on processes of structural integrity assessment, to collaborate on specific projects, and to promote the harmonization of international standards. The traveler took part in meetings of the Evaluation Task Group (TG5) on March 9 at GRS, Köln, Germany and in meetings of the Steering Committee (SC) of the NESC on March 9-10 at the same location. The TG5 and four other TGs were organized within the NESC to provide support for planning and execution of the large-scale NESC-1 spinning cylinder project. The NESC-1 experiment will be conducted at AEA Technology, Risley, U. K. for purposes of assessing behavior of subclad and through-clad cracks under thermal-shock loading. The traveler serves as a member of the Structural Analysis Task Group (TG3) and the SC through support provided by the U. S. Nuclear Regulatory Commission; he participates in TG5 as Vice-Chairman/U. S. A. of the SC; he provides technical support to the Materials Task Group (TG2) and the Instrumentation Task Group (TG4).

The NESC-1 Project Manager summarized the current status of the Project and the progress made since the last meeting. Difficulties were experienced by MPA with initiating and growing the large subclad fatigue crack. Residual stresses resulting from the welding fabrication process were confirmed as the cause of the problem. Crack initiation and growth were achieved after tensile stresses were introduced in the cylinder by applying a large constant external load across a diameter. Next, a number of artificial defects were introduced according to a specification provided by the Reference Laboratory (RL). Currently, the cylinder specimen is at Framatome, Challon, France, where work has commenced to introduce additional subclad defects and to apply the cladding layer.

Completion of the cylinder specimen has been delayed until August/September 1995. At that time, the inspection phase should commence and run approximately 34 weeks to accommodate the six to eight participating teams. Following completion of the inspections in May 1996, the cylinder specimen will be returned to Risley for instrumentation and testing during September/October 1996.

In the meeting of TG5, reports were received from the chairmen of the other four TGs (1-4) and several recommendations to the SC were drafted. Task Group 1 recommended approval for a Russian inspection team and for an eight-month inspection period accommodating up to eight teams. Task Group 2 recommended that approval be given to a post-clad heat treatment of 550°C for two periods of six hours each. Additional recommendations included a limited amount of shallow-crack beam testing for constraint characterization. The report from TG3 provided recommendations concerning parameters for the shallow-crack beam testing program. Priority should be given to 70 mm x 70 mm beams having a crack depth to specimen width ratio of $a/W = 0.1$; a test temperature of 60°C was proposed. Traveler presented results from ORNL analyses indicating that interaction between the two large cracks in the cylinder during the thermal-shock test should be minimal. Task Group 4 recommended postponing a final decision on crack growth monitoring techniques until additional studies are completed.

The SC meeting began with an announcement from B. Hemsworth, chairman of the SC, that he was retiring from the U. K. Nuclear Installation Inspectorate, but would continue as SC chairman. All of the proposals drafted during the meeting of TG5 were adopted by the SC. A draft proposal for a NESC-2 Project that would focus on a pressurized-thermal-shock (PTS) testing program was put forward by the chairman of TG5. The overall technical goal is to improve the safety of the VVER-440 reactors, as well as other reactors exposed to irradiation embrittlement. The objective of the proposed project is to investigate and verify the accuracy of current fracture methodologies used for structural integrity assessments of RPVs having lower bound toughness properties. Relevant issues will be addressed in a series of eleven large-scale benchmark experiments to be carried out at three different testing facilities, including the Russian PTS facility at Prometey. The next series of NESC meetings will be in Rome during September 1995.

Discussions were held with researchers at Gesellschaft für Anlagen-und Reaktorsicherheit (GRS), Köln, Germany concerning the completion of Phase II of the Project for Fracture Analysis of Large-Scale International Reference Experiments (FALSIRE II). Project FALSIRE is organized by the Fracture Assessment Group (FAG) of the Organization for Economic Cooperation and Development/Nuclear Energy Agency's (OECD/NEA) Committee on the Safety of Nuclear Installations (CSNI) Principal Working Group No. 3 (PWG-3). On behalf of the CSNI/FAG, the RPV International Program Support Project at ORNL and GRS, has responsibility for FALSIRE organizational arrangements. At GRS, the Organizing Committee (OC) for FALSIRE II worked on evaluating additional information and analysis results submitted by testing organizations and participants and on developing an outline for the final report on FALSIRE II. New proposals for future CSNI/FAG activities related to reactor safety assessments were also discussed.

1. Introduction

The primary purpose of this trip (itinerary given in Appendix A) was to participate in two meetings concerning the international Network for Evaluating Steel Components (NESC). The traveler attended a meeting of the Evaluation Task Group (TG5) that was held at GRS, Köln, Germany, on March 9, 1995. This were followed by meetings of the Steering Committee (SC) of the NESC on March 9-10, 1995, at the same location. These task groups were organized within the NESC to provide support for various elements of the large-scale NESC-1 spinning cylinder project and to advise the NESC on test parameters. The NESC-1 experiment will be conducted at AEA Technology, Risley, U.K. for purposes of assessing the behavior of subclad and through-clad cracks in simulated degraded reactor pressure vessel (RPV) material under thermal shock loading. The traveler provides technical support to the Materials Task Group (TG2), to the Structural Analysis Task Group (TG3), and to the Instrumentation Task Group (TG4) through funding provided by the NRC. The traveler participates in the activities of TG5 through his position as Vice-Chairman/U. S. A. of the SC.

The traveler also participated in a series of meetings of the OC for Phase II of Project FALSIRE. These meetings of the OC, held at GRS, Köln, focused on evaluating additional information and analysis results submitted by testing organizations and participants and on developing an outline for the final report on FALSIRE II.

2. Network for Evaluating Steel Components (NESC)

2.1 Objectives, Organization, and Focus of the NESC Program

The NESC is sponsored jointly by the U.K. Health and Safety Executive (HSE) and the Commission of the European Communities (CEC), and is intended to promote development of a network of participating international organizations to exchange information on the safety assessment of steel components used in the nuclear industry. The countries participating in the NESC Project include several in Europe (Belgium, United Kingdom, France, Germany, Holland, Spain, Italy, Sweden, Finland, Switzerland) as well as Japan and the United States.

The organizational structure of the NESC is shown in Fig. 1 along with the current roster of officers. Technical and administrative management of the NESC and management of collaborative activities related to specific projects are performed by the Operating Agent and the Reference Laboratory (RL), namely, the Joint Research Center (JRC)/IAM, Petten, Netherlands. It is envisioned that several projects can be managed concurrently by the NESC. Specific projects each have a Steering Committee to define the technical requirements, interact with the Project Manager, coordinate joint activities, and monitor progress. The activities themselves are undertaken by the participating organizations. For the NESC-1 Project, the RL interacts with five NESC task groups [Inspection/Non-destructive Evaluation (NDE) (TG1), Materials (TG2), Structural Analysis (TG3), Instrumentation (TG4), and Evaluation (TG5)] that support an NESC large-scale testing project described in the following section.

Members participate in activities of the NESC at their own expense and are expected to make "in kind" contributions. Expenses related to management of the NESC and collaborative activities are borne by the Operating Agent and the RL. Particular projects, such as the large-scale tests described below, are sponsored by individual members of the NESC.

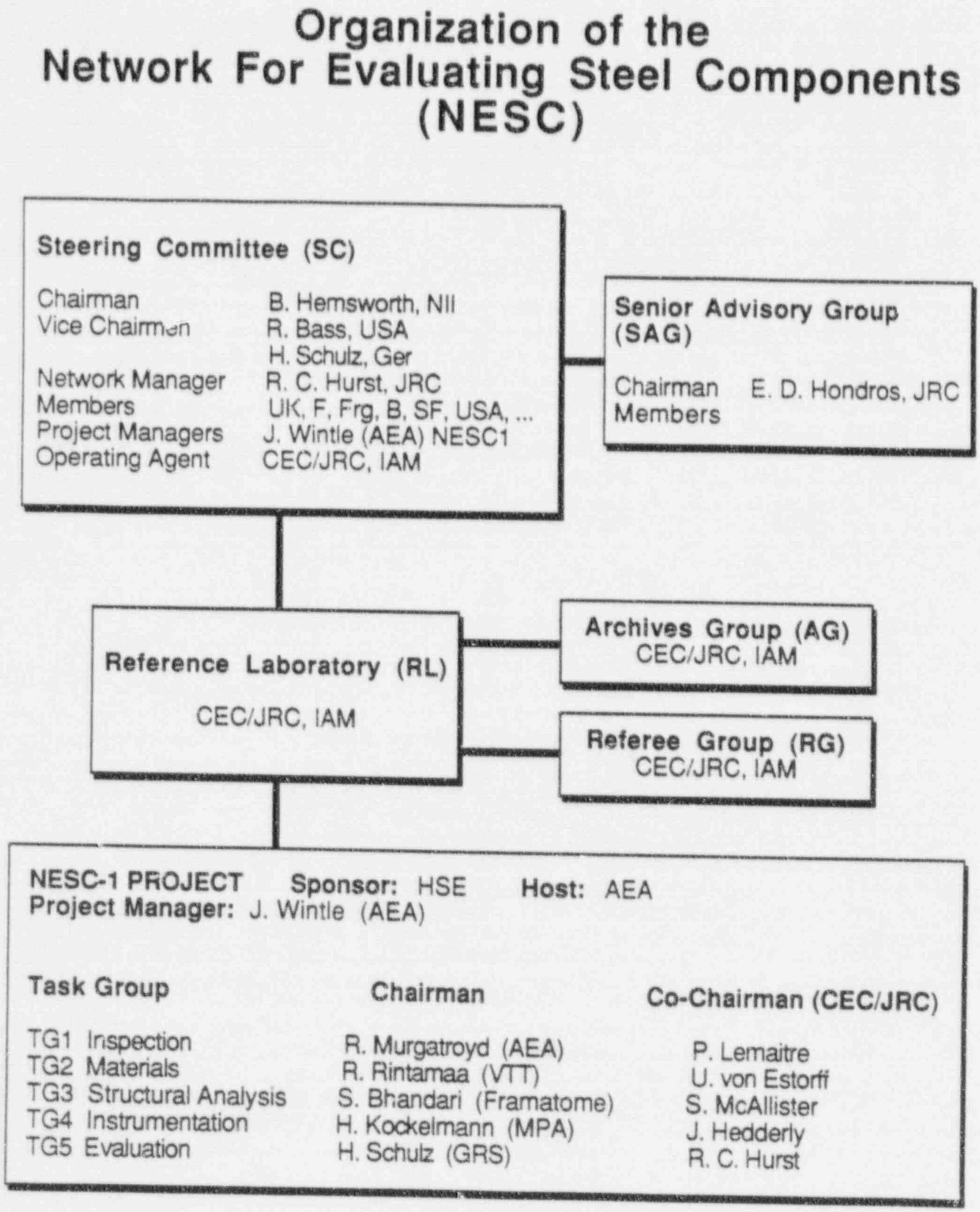


Fig. 1 Organization of NESC

2.2 NESC-1 Spinning Cylinder Project

The NESC is first focusing on a research project funded by HSE to study the total process of structural integrity assessments of aged RPVs containing subclad cracks. The intent is to have the problem studied by a wide range of organizations involved in RPV safety assessment. In this project, important safety assessment issues will be investigated by means of inspection and analysis of a spinning cylinder test which is to be performed at the AEA Technology fa[illegible]ity at Risley, U.K.

The project consists of several phases. A thick cylinder will be fabricated from A508B class 3 steel (inner diameter of 1.15 m; wall thickness of 170 mm; length of 1.3 m; and weight of 8 tons). The cylinder will be heat treated with the aim of producing fracture toughness properties and residual stresses representative of those in the beltline region of an RPV after 30 years service. Several cracks of varying sizes will be inserted in the inner surface prior to application of stainless steel cladding. In the pretest phases of the project, the size and location of the subclad cracks will not be revealed by the project management team and the NESC management. Characterization blocks will be fabricated in parallel with the cylinder for determination of tensile and fracture toughness properties of the cladding, heat-affected zone (HAZ), and base material.

The cylinder will be made available for inspection by teams using NDE techniques. It is anticipated that the teams will employ methods used for in-service inspection of actual RPVs and apply them under conditions that are as realistic as possible. Findings and interpretations (from the inspection teams) will be reported to the NESC management.

Other organizatior participating in the NESC project will perform safety assessments of the crack [illegible] on interpretation of inspection results, specified pressurized-thermal-shoc[illegible]ading, and materials property data. The same methods used to assess defects in an actual RPV would be applied. Results of these assessments will be reported to the NESC management.

After the pretest inspections and assessments, the cylinder will be fully instrumented and tested in the spinning cylinder test facility at Risley. The actual test conditions will be determined from recommendations made by TG3. Data from the test, including temperatures and rotational speeds, will be available for posttest analysis. Following the test, the cylinder will be made available to the teams for inspection. Based on results of the posttest inspections, the safety assessments will be updated. Then, the cylinder will be destructively examined to determine the dimensions of the initial cracks and the extent of crack propagation during the test. Comparisons will be made between the pretest and posttest inspections and safety assessments and the observed size and evolution of the cracks. The results of the project will be collated and published. Currently, the NESC spinning cylinder project is scheduled to run through 1996.

2.3 Evaluation Task Group (TG5) Meeting

The meeting of TG5 was held at GRS, Köln, Germany, on March 9, 1995. The list of attendees and agenda for the meeting are given in Appendices B and C of this report. The principal objectives of TG5 are (1) to assure communication and integration of the actions of all TGs, (2) to monitor progress and provide recommendations on the direction and objectives of the NESC-1 Project, and (3) to enable the assessment and evaluation of results from the Project and their dissemination to third parties. Membership of TG5 is composed of the nominated chairman and co-chairman, as well as the chairman and co-chairman of the other four TGs. Officers of the SC attend TG5 meetings as observers (the traveler participates in the TG5 meeting as the Vice-Chairman/U. S. A. of the SC). The TG5 chairman and co-chairman are H. Schulz, GRS, Köln, Germany, and R. Hurst, CEC/JRS, Petten, respectively.

Task Group Reports

After approval of the minutes from the September 1994 meeting in Stockholm, the TG5 received reports from the task group chairmen.

TG1 - Inspection. R. Murgatroyd, AEA Technology, U. K., reviewed the current status of inspection team participation in the NESC-1 project. The status report (given in Table 1) indicates that five countries have made definite commitments to provide inspection teams. Participation from three additional countries is thought to be likely, i.e., France, Germany, and Russia. The TG1 chairman urged that the SC be requested to seek definite indications from France and Germany in the near future concerning their plans for participation. Also, he pointed out that a decision must be made in the next two-three months concerning Russian participation in the inspection program. It is anticipated that VTT will work with a team from the Leningrad Power Plant to perform an inspection of the cylinder at the VTT facilities in Finland.

It was noted that scheduling problems for the inspections could develop should eight countries commit to participation in the inspection program. Currently, it is anticipated that the completed cylinder specimen will be available for inspection in September 1995. Allowing one month for each of eight teams to perform an inspection, the earliest date for completion of the inspection program would be May-June 1996.

J. Wintle, NESC-1 Project Manager, indicated that schedule and budgetary constraints require that the cylinder be returned to Risley by Summer 1996. This schedule would permit testing of the cylinder to be completed before the end of 1996.

Other recent activities of TG1 focussed on the design of calibration blocks that will be provided to the inspection teams. Preliminary design drawings for the calibration blocks were prepared by TG1 and circulated to the current roster of inspection teams for evaluation. Several of these groups have responded to TG1 with suggestions for modifications to the design.

Table 1. Summary of inspection team participation in the NESC-1 Project

Country	Status of Participation
1. **Finland**	VTT will participate
2. France	Discussions in progress
3. Germany	Discussions in progress
4. Russia	Discussions in progress
5. **Spain**	Tecnatom will participate
6. **Sweden**	ABB-TRC will participate
7. **United Kingdom**	NE will supervise participation
8. **U. S. A.**	PNL will participate

Recently, data sheets for reporting results of the inspections were redrafted by TG1 in response to criticisms that surfaced at the Stockholm meeting of the SC. In the near future, these new data sheets will be circulated to the inspection teams for a dummy exercise. Also, copies will be provided to TG3 (Analysis) for its evaluation.

Finally, TG1 requested that the Project Manager confirm the absence of oil in the fatigue cracks placed in the cylinder. In the next few weeks, Framatome will be asked to perform this task to ensure that the acoustic impedance of the large fatigue flaws is not changed by the presence of residual oil from the fatiguing process. (The cylinder is currently at Framatome-Challo[illegible] ndergoing the cladding process).

TG2 - Materials. R. Rentamaa summarized activities carried out by TG2 since the previous TG5 and SC meetings held in Stockholm. A meeting of TG2 was hosted by Framatome at Challon, France, during December 12-13, 1994, to approve the NESC-1 material characterization program and to allocate work among the contributing organizations. A draft document was produced which details the TG2 materials characterization program for determining mechanical and physical properties of the forging, the cladding, and the heat-affected zone (HAZ). The main focus of the program is (1) to provide additional material properties data for evaluating the effects of post-weld heat treatment (PWHT) on fracture toughness of the forging material and on properties of the cladding and HAZ, (2) to assure the qualification of the narrow-gap submerged arc weld (NGSAW) procedure used for fabrication of the cylinder, and (3) to provide data for evaluating the effects of constraint.

In support of the material characterization program, Framatome-Challon successfully clad an arc of the SC-4 cylinder material and then heat treated the arc specimen for 12 hours at 550°C. The arc was sectioned into blocks that will provide source material for the characterization program. Figure 2 depicts the cutting plan that was used for sectioning the cladded arc specimen. The testing program and the participating organizations that will carry out the characterization testing are given in Table 2.

Most of the characterization blocks have been distributed to the participating testing organizations. Preliminary results from the testing program are expected within the next three months. These results will be presented at the next meeting of TG2 which is scheduled for June 29, 1995. A report on material characterization data will be distributed to the SC for final acceptance at the next meeting in September 1995.

Completion of the material properties data report is awaiting receipt by TG2 of relevant data on the austenitic stainless steel cladding. An action item calls for the RL to request that Framatome provide the specified data (i.e., mechanical properties, [illegible]emical composition, etc.) for the cladding applied to the test arc and to the cylinder specimen. After the cladding data have been transmitted to TG2, a draft report on the material properties data will be prepared and distributed to members of TG2 and TG3 for comments.

Data on fracture toughness properties of the cylinder material after exposure to the planned post-cladding heat treatment has been provided by The Welding Institute (TWI). Comparison of the post heat-treatment toughness data with the original data for SC-4 material indicated that no significant change in toughness should occur due to the planned heat treatment. Thus, the final heat treatment of the cylinder will be split into two phases: (1) an initial phase of 6 hours at 550°C applied to the cylinder with full cladding thickness; and (2) a second phase of 6 hours at 550°C applied to the cylinder after the cladding thickness is reduced to 4 mm in a final machining step.

The NGSAW procedure used in fabrication of the NESC-1 cylinder specimen has not been qualified for the lower temperature selected for the post-cladding heat treatment. Thus, an action item was prepared calling on the RL to find a participant willing to perform fracture toughness tests or other appropriate tests to ensure the integrity of the weld during the PTS experiment.

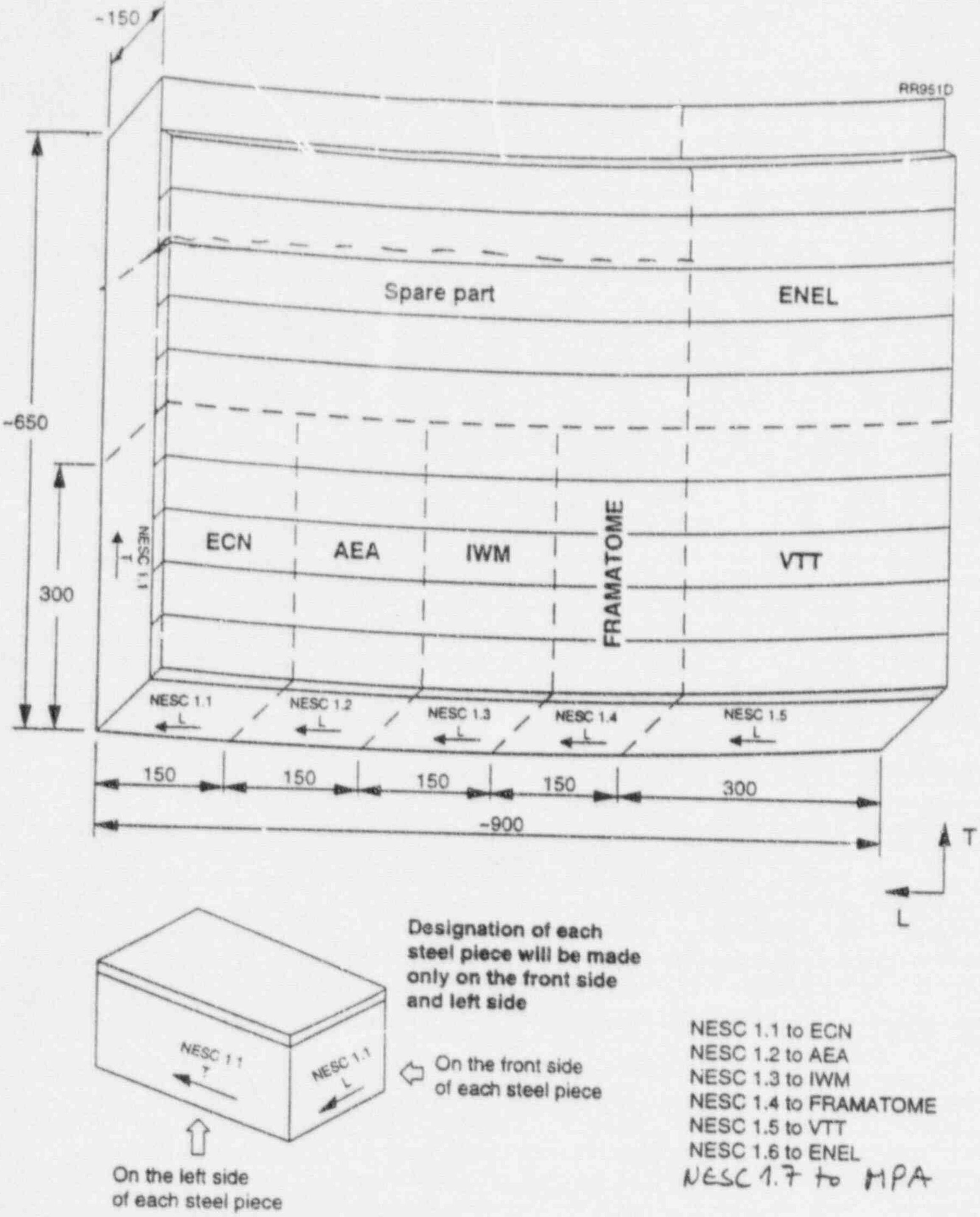


Fig. 2 Cutting plan for sectioning the cladded arc of SC-4 material

Table 2. Work allocation among participating organizations

Test	Clad Metal	HAZ	Base Metal
True σ-ε			
• standard as f(T)			
– T-orientation			ENEL
– L-orientation			ENEL
• miniature as f(T)			
– L-orientation	AEA, IWM	AEA, IWM	AEA, IWM
Impact Tests			
• CVN as f(T)			
– L-T-orientation	nd	nd	VTT
• PCVN as f(T)			
– L-T-orientation	nd	nd	VTT
K_{Ic}, K_{Jc}			
• standard as f(T)			
– L-T-orientation	np	np	VTT, ENEL
• miniature as f(T)			
– L-T-orientation	ECN, IWM	ECN, IWM	VTT
• shallow-flaw bend			
– constraint models	np	np	Framatome
K_{Jd}			
– L-T-orientation	nd	np	VTT
K_{Ia}			
• standard as f(T)			
– L-T-orientation	np	np	MPA
• correlation	np	np	VTT

nd = not determined
np = not possible
f(T) = function of temperature

<u>TG3 - Structural Analyses.</u> S. Bhandari briefly reviewed a technical paper [1] co-authored by the co-chairmen of TG3 (Bhandari and McAllister) that will be presented at the ASME PVP Conference in July 1995. The paper summarizes the recently completed pretest analyses performed by the contributing members of TG3. Results from both simplified methods and finite-element analyses are described which elucidate the influences of experimental variables such as cylinder geometry, loading conditions, and material properties on the propensity for achieving a cleavage initiation event in the NESC-1 test. (The summary paper included results from a series of 3-D thermoelastic and elastic-plastic finite element analyses of the cylinder that were performed by J. Keeney at ORNL.)

The chairman also discussed results of analyses that were performed by several members of TG3 to address specific issues raised during the previous Stockholm meetings. D. Moinereau, EdF, re-analyzed the spinning cylinder based on a 70-mm-deep subclad flaw and the measured dimensions of the reconstituted cylinder which is currently undergoing the cladding process. The analysis, which utilized a 3-D thermoelastic finite-element model, produced results which were not qualitatively different from those previously reported for models with somewhat different dimensions.

J. Brochard, CEA-Saclay, performed a series of constraint analyses to assist TG2 in defining a test matrix for the material characterization program (see Table 2). These analyses focussed on three-point bend specimens containing through-cracks with depths representing a range of a/W ratios. The conclusion from this study was that first priority should be given to shallow-crack beams with crack depth ratio a/W = 0.1 and test temperatures in the range 70 - 100°C.

During subsequent discussions of these constraint analyses, J. Sievers, GRS, and the traveler proposed that priority should be given to beams having a crack depth ratio of a/W = 0.1, but with a lower test temperature of 60°C. (The 60°C test temperature is based on ORNL analysis results and toughness data from the SC-4 spinning cylinder experiment). Also, it was requested that load versus crack-mouth opening displacement (CMOD) data be recorded during the tests. Beam specimens having a 70 mm x 70 mm cross-section will be fabricated for this series of shallow-crack toughness tests.

As an action item from the Stockholm meetings, ORNL was requested to perform additional three-dimensional finite-element analyses of a cylinder containing deep cracks located at 90° intervals around the circumference. The purpose of these analyses was to determine the extent of interaction between multiple cracks in the cylinder. (The test cylinder will contain two large cracks spaced at 90° intervals, one of which is subclad and the other through-clad.) These analyses were completed by J. Keeney at ORNL and reported in Ref. 2 during December 1994.

The traveler presented results from the ORNL analyses which indicated that the stress-intensity factor changes less than 0.2 percent between a model with one crack and a model with four cracks evenly spaced around the circumference. Thus, it was concluded that interaction between the two large cracks in the NESC-1 specimen during the thermal shock test would be minimal.

The ORNL analyses also predicted the effects of lowering the initial cylinder temperature from 320°C to 295°C. These results indicated that a lower initial cylinder temperature increases the probability of achieving cleavage initiation of the through-clad flaw.

<u>TG4 - Instrumentation.</u> The chairman, H. Kockelmann, provided a review of several issues that are being studied by the task group.

Arrangements have been made to monitor the cladding process being carried out at Framatome-Challon. A series of thermocouples will be installed on the cylinder to monitor the temperature during the cladding process. Framatome will be responsible for actually recording and processing the thermocouple data.

A plan was proposed for performing residual stress measurement on the cylinder specimen at selected times during the project. Residual stresses would be determined as follows:

- after the cladding process is completed at Framatome-Challon;
- after the post-machining heat treatment is carried out at MPA;
- after the spinning cylinder test.

In each case, residual stresses will be determined using the "ring core" method, in which spark erosion is used to cut a 10-mm-deep by 14-mm-diameter groove around a strain-gaged region of the cylinder.

General instrumentation of the cylinder specimen will include thermocouples for temperature measurements, strain gages, transducers for measuring rotational speed, as well as parameters related to the thermal-shock coolant, such as inlet and outlet temperatures and the flow rate. Also, measurements of CMOD will be made on the large through-clad crack. The RL has indicated that it will be responsible for making post-test measurements of the global dimensions of the cylinder specimen.

Instrumentation options for detecting crack initiation and propagation of the large through-clad and subclad cracks in the cylinder are still being studied. The instrumentation must be capable of determining the time at which crack growth events occurred for both cracks. Two methods that were considered are (1) the alternating current potential drop

(ACPD) technique used in all of the previous spinning cylinder tests for surface breaking cracks and (2) strain gage (SG) techniques. The ACPD has never been effective for detecting crack initiation in the spinning cylinder specimen. P. Nurkkala, Imatran Voima (IVO), Finland, has provided data to TG4 from the Central Research Institute for Structural Mechanics (CRISM) - Prometey, Russia, which indicate that strain gages may be useful for detecting initiation of both through-clad and subclad cracks. The IVO experience is based on the use of Ailtech weldable strain gages spanning a surface-breaking crack to detect brittle crack initiation in clad RPV steels.

Recently, IVO performed additional validation tests on the SG technique in which strain gages were used to detect crack initiation in test specimens. In the next few weeks, IVO will section the test material and compare the measured crack growth behavior with the recorded strain gage data. Results from this assessment will be used by TG4 to formulate a recommendation concerning the appropriate crack-growth monitoring technique. A decision on this matter should be forthcoming by September 1995.

Also, TG4 is studying methods of sealing the through-clad crack after the thermal-shock test is completed. The objective is to protect the crack surface from corrosion and to keep the crack stable for UT inspection after the test. The TG4 and the RL are working together to identify a technique for resolving this problem.

<u>Summary</u>

The TG5 chairman provided a brief summary of the status reports and recommendations from the four TG (1-4) chairmen that would be submitted to the meeting of the SC. The principal recommendations to the SC were given as follows:

- Approval for a Russian inspection team drawn from an industrial background;
- Approval for an eight-month inspection period accommodating up to eight teams;
- Ensure cracks are free of oil and water for inspections;
- Approval of post-clad heat treatment of 550°C for two periods of six hours each;
- Approval of a limited amount of shallow-crack beam testing for constraint characterization;
- Approval of characterization of weld run-out to ensure qualification of NGSAW procedures used in cylinder fabrication;
- Postpone final decision on crack growth monitoring technique until the IVO validation study is completed.

2.4 Steering Committee (SC) Meeting

Meetings of the SC were held at GRS, Köln, Germany, on March 9-10, 1995. The agenda for the meeting is given in Appendix D of this report. The chairman of the SC is B. Hemsworth of the Nuclear Installations Inspectorate (NII), U.K.; other officers and members of the SC are identified in Appendix E.

The chairman began the meeting by announcing his retirement from the HSE effective March 17, 1995. However, he indicated that he will continue to serve in his role as chairman of the SC.

Network Management Report

The Network Management Report was presented by R. Hurst, JRC, Petten, in his role as the Network Manager. A summary of the report is given below.

One change has been requested in the membership of the SC, with D. Lidbury being nominated by AEA Technology to replace A. Clayton as a non-voting member of the SC. An additional request for membership on the SC was received from Rolls Royce and Associates, who nominated R. Palframan as their representative. Both proposals were approved by the SC.

No meeting of the NESC Senior Advisory Group (SAG) could take place due to the retirement of the SAG chairman. A SAG meeting will be planned before the next SC meeting in September 1995 to permit the SAG to address the NESC-2 project (described below).

The RL has taken action in three areas since the last SC meeting. The first action concerns decisions related to insertion of the subclad fatigue defects, the EDM defects, and the so-called "natural" subclad defects in the cylinder specimen. This action has successfully reached the stage where the last step related to insertion of the "natural" defects is under way. Information concerning all of these defects is treated as confidential to the RL. The manufacturers of the defects, i.e., MPA and Framatome, have been requested to observe the confidentiality agreement. The second action refers to completion of the design for the calibration block and the artificial defects to be inserted in the cylinder for inspection purposes (see discussion of the TG1 report given in the meeting of TG5). The third action refers to the recently completed distribution of test material to the members of TG2 (see discussion of the TG2 report given in the meeting of TG5).

The Network Manager listed five items that are not yet covered financially in the NESC-1 Project. These are given as follows:

1. Any additional costs to the fixed price contract with MPA which may be incurred due to assignment of additional tasks for the insertion of defects.

2. Additional costs incurred by Framatome related to heat treatment and cutting of the arc for the material tests.

3. Any additional costs to be incurred by Framatome, including the first post-cladding heat-treatment (cost unknown at the present time).

4. Cost of post-machining heat treatment (second stage) of the cylinder.

5. Material testing on weld run-outs related to cylinder fabrication.

Currently, the Network Management is participating in activities related to three potential NESC projects:

1. The NESC-2 project being developed in conjunction with the Russian organizations;

2. The development of a Corrosion project within NESC or a Corrosion Network;

3. A program to consider the application of Codes for defect assessment procedures in non-nuclear European industry.

(These projects are addressed below under the sections concerned with Future NESC Projects).

NESC-1 Project Management

The report from the NESC-1 Project Manager, J. Wintle, summarized the current status of the NESC-1 Project and the progress made since the last SC meeting in Stockholm/Helsinki during September 1994.

At the time of the last SC meeting, difficulties were being experienced by MPA with initiating and growing the large subclad fatigue flaw. Residual stresses resulting from the welding fabrication process were suspected as the cause of the problem. This was confirmed when residual stress measurements made on the surface were found to be consistent with theoretical assessments. A proposal was made to introduce tensile stresses in the cylinder by applying a large constant external load across a diameter. This step was accomplished by placing the cylinder in a large testing machine. After a few trials, crack initiation was achieved and growth continued without further difficulty. The final crack size was measured by the ultrasonic modulation technique to an accuracy of +/- 2 mm.

The inside surface of the cylinder was then machined to remove the starter notch and to introduce loading pockets for support of the cylinder in the spinning cylinder facility. Next, a number of artificial EDM defects were introduced according to a specification provided by the RL.

Currently, the cylinder specimen is at Framatome, Challon, France, where work has commenced to introduce additional subclad defects. After this phase is completed, the cladding layer will also be applied by Framatome.

Because of several factors, completion of the cylinder specimen has been delayed until August/September 1995. At that time, the inspection phase should commence and run approximately 34 weeks to accommodate the six to eight participating teams. Following completion of the inspections in May 1996, the cylinder specimen will be returned to Risley for instrumentation and setting up the test. The actual test is expected to take place during September/October 1996. An updated schedule of key events and dates for the Project are provided in Fig. 3 and in Table 3.

Reports from Task Group Chairmen

Presentations and proposals from the individual Task Group chairmen were essentially the same as those made at the TG5 meeting and described in earlier sections of this report.

Table 3. Schedule of key events for NESC-1 Project

Date	Event
August/September 1995	Complete manufacture of cylinder
August 1995	Complete material characterization
May 1996	Complete team inspections (pretest)
October 1996	Perform spinning cylinder test
December 1996	Complete preliminary report

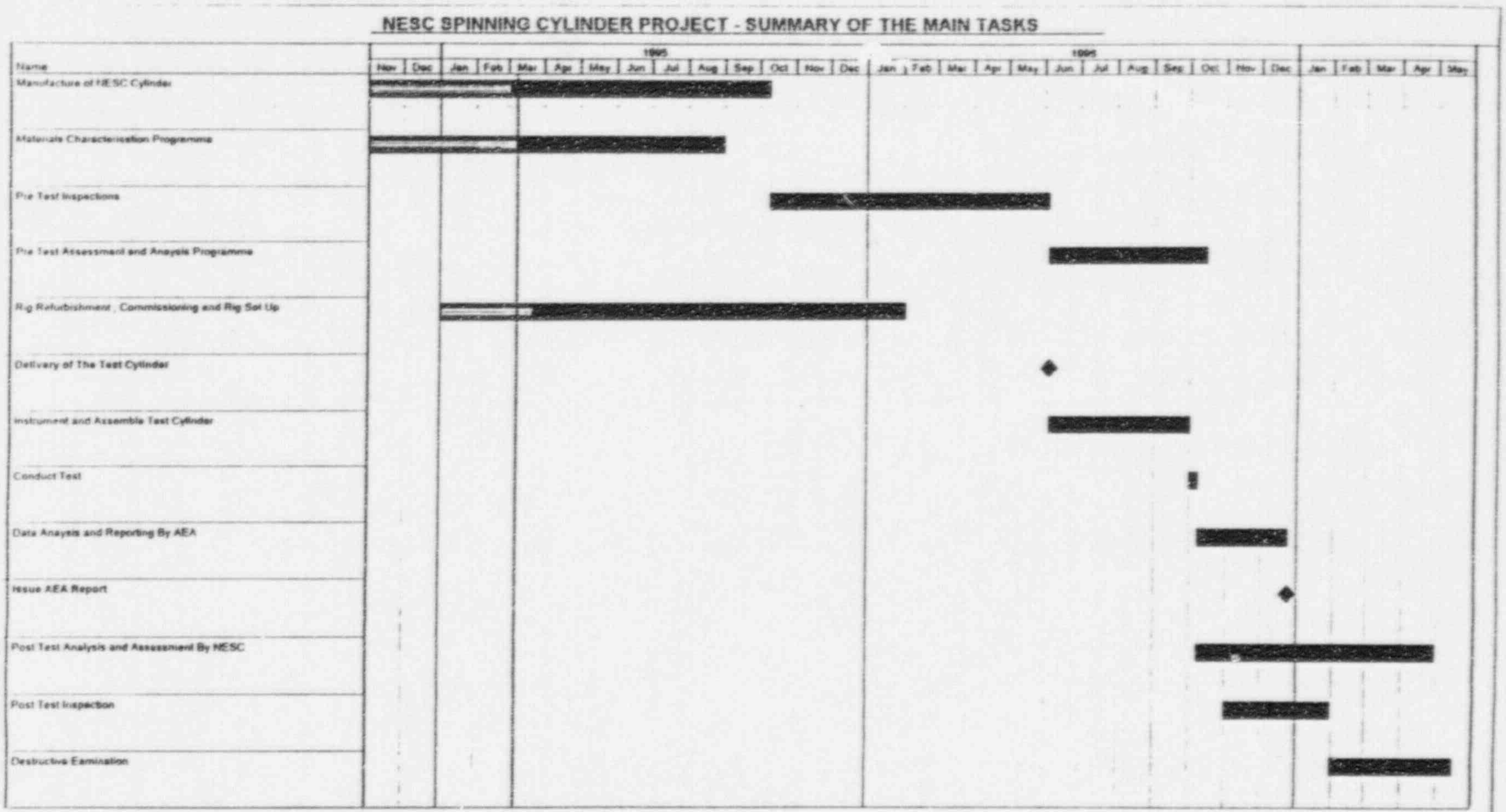
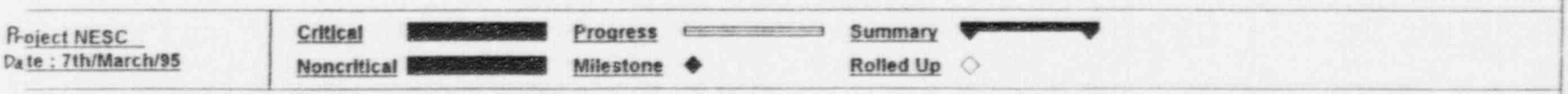


Fig. 3 Schedule of events for NESC-1 spinning cylinder project



Approval of Proposed NESC-1 Actions

All of the proposals listed in an earlier section of this report describing the TG5 meeting were approved by the SC. The RL was assign the task of locating a volunteer organization to perform the characterization of the weld run-out to ensure qualification of NGSAW procedure used in cylinder fabrication. Also, the RL was given responsibility for making post-test measurements of the cylinder geometry and of residual stresses.

NESC-2 Project (with CR[illegible] Prometey)

At the Sheffield meeting in September 1993, a preliminary proposal concerning PTS testing was received from the CRISM (Prometey) Institute in St. Petersburg, Russia. A revised (but incomplete) version of this proposal was presented by H. Schulz, GRS, at the SC meeting in Helsinki during September 1994. At the Köln meeting, Schulz introduced a fully developed proposal that was jointly produced by GRS, JRC/IAM, Prometey, and VTT, and entitled

"Extended Verification of the Structural Integrity Assessment Procedures for Reactor Pressure Vessels of CrMoV-type Steels."

The proposal states that the overall technical goal of the project is to improve the safety of the VVER-440 reactors, as well as other reactors exposed to irradiation embrittlement. The project is intended to be of interest to a wide number of international organizations concerned with RPV integrity, including those in Russia.

In the foreseeable future, more than 25 VVER-440 reactors in the CIS and Eastern Europe, as well as two additional reactors in Finland, are likely to continue operation, despite concerns relating to their safety. The safety assessments performed for several VVER-440/230 and VVER-440/213 plants indicate that irradiation-induced embrittlement of the near-core welds is likely to be a limiting factor regarding the safe operation of some plants.

The objective of the proposed project is to investigate and verify the accuracy of current fracture methodologies used for structural integrity assessments of RPVs having lower-bound toughness properties. Relevant issues will be addressed in a series of benchmark experiments to be carried out at three different testing facilities. A large-scale experimental program has been developed that calls for testing of 11 model vessels in three test series. Five vessels will be tested at Prometey, three vessels at MPA and three at AEA Technology. By performing the experiments in different test facilities, it will be possible to investigate a range of crack loading conditions.

Irradiated conditions for the base, weld and cladding material at end-of-life (EOL) will be simulated using heat treatment procedures derived from extensive work performed at Prometey. Results of the project will facilitate comparisons of the fracture resistance of CrMoV-type steels to that of the CrMo or MnMo types.

Special attention will be paid to the influence of different crack sizes, constraint effects, uniform and non-uniform (e.g. asymmetric cooling) loading conditions, and the effects of cladding on crack initiation and crack extension. In addition, the effectiveness of current methods used by utilities during in-service inspection of RPVs for detecting and sizing sub-surface weld defects, as well as subclad and through-clad cracks, will be evaluated.

The proposed project should supplement results currently being generated within the NESC-1 project and other EC-supported programs such as TACIS and PHARE, which are considering the integrity assessment of components and the characterization of material behavior. Additional contributions will be made to the world-wide data base of thermal-shock experiments for use in verification of integrity assessment procedures. The project can also provide a focal point for further international cooperation and technology transfer in the areas of NDE technology, instrumentation, material characterization, and structural analysis.

The work program for the project is subdivided into several phases, as depicted in Fig. 4. The primary focus is on evaluating the accuracy of the current structural integrity assessment procedures for RPVs under lower-bound toughness (EOL) material conditions. The main deliverable of the project will be a verified structural integrity assessment procedure for RPVs with low fracture toughness. A brief summary of the work program is given below.

Phase 1: Test parameter evaluation. Boundary conditions and specification of test parameters will be performed by means of structural analysis simulation of the experiments. A variety of methods will be applied to this end.

Phase 2: Fabrication of material for model vessel forgings. The objective of this phase is to fabricate forgings from one large steel melt (150 tons). The manufacturing process will be similar to that for a real VVER-440 RPV. However, special heat treatment will be used to reduce the fracture toughness of the base metal to a level representative of the lower bound toughness of the circumferential weld of the reactor core region in an EOL condition. A range of material testing will be performed to verify that the post-heat treatment material properties are representative of the specified EOL conditions.

Phase 3: Fabrication and preparation of all model vessels and steel plates. Fabrication of all model vessels and steel plates will be completed according to the geometric specifications recommended in Phase 1 and to the specific requirements of the test rigs.

Phase 4: Material characterization program. Mechanical properties and fracture toughness for simulated EOL will be determined. Fracture toughness testing will focus mainly on studying the effects of constraint and crack depth on cleavage fracture.

Phase 5: Testing program on wide plates. Instrumentation techniques will be verified and shallow crack constraint effects will be evaluated by performing tests on wide plates with different crack configurations. The resultant experimental data will be used for verification of fracture assessment methods.

Phase 6: Non-destructive inspection on model vessel. The effectiveness of NDE methods for sizing through-clad cracks and detecting and sizing subclad weld defects will be studied. At least one vessel selected from the model vessel testing program with cladding and axial or circumferential welds will be used for the NDE exercise. Different sizes and types of real defects will be inserted into the vessel.

Phase 7: Testing program on model vessels.

Test series 1. Four unclad model vessels with surface cracks will be tested in a test rig in which heated vessels are exposed to forced and non-uniform (strip) cooling. Fracture toughness of the vessel material will correspond to a transition temperature of 170°C. Tests will be performed at Prometey, MPA, and AEA Technology.

Test series 2. Four clad model vessels with circumferential and axial through-clad cracks will be tested in the test rig in which heated vessels are exposed to forced uniform (Prometey, MPA) and non-uniform (Prometey, AEA) strip cooling. Fracture toughness of the vessel material will correspond to a transition temperature of 170°C. Fracture resistance of the cladding should be relatively low.

Test series 3. Three clad and welded model vessels with a through-clad crack in the weld will be tested in different test rigs. Both uniform (MPA) and non-uniform (Prometey, AEA) cooling will be applied. Fracture toughness of the base metal and weld metal will correspond to the transition temperatures of 80°C and 170°C, respectively.

Phase 8: Data evaluation and verification of structural integrity assessment methods. Experimental and computational data from all tests and fracture assessment analyses will be compared and verified.

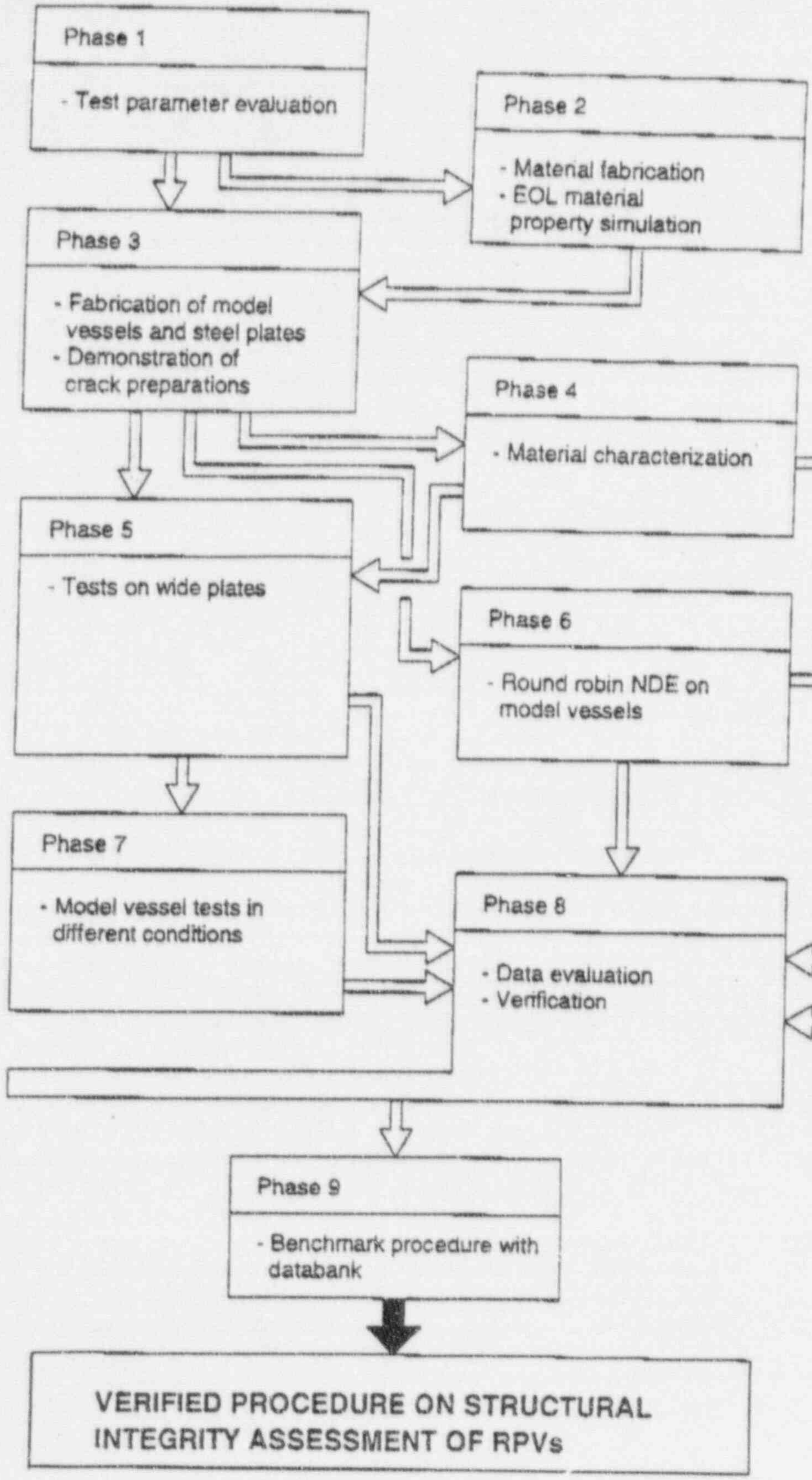


Fig. 4 Organization of the proposed NESC-2 Project

Phase 9: Benchmark procedure with databank. Experimental and computational data from all tests and fracture assessment analyses will be collected in a systematic way to create a benchmark procedure with a wide range of data. The procedure can be used for future structural integrity assessments of VVER-440s and other RPVs.

Phase 10: Generic recommendations and summary. The purpose of this phase is to guarantee detailed documentation of the completed work program.

Funding for the NESC-2 project would be split between the CEC and other national funding organizations (which were not identified). The total cost of the project was estimated to be approximately five-six million ECU, which would be spread over a three-four year period. Should the project be approved, it is anticipated that work would start at the beginning of 1996.

At Köln, discussion of the NESC-2 project within the SC focussed on questions concerning the level of support that could be anticipated from the member organizations represented on the SC. It was predictable that strong support for the project would be expressed by representatives of those organizations involved in the large-scale testing program. Other members of the SC expressed varying degrees of uncertainty, pending further discussions back home with their sponsoring organizations. The traveler's response was in the latter category; he agreed to discuss the proposal with the NRC Technical Monitor and provide feedback concerning the level of NRC interest at the next SC meeting in Rome.

Future NESC Projects

Several other proposals and concepts for future projects within the NESC are being considered by the SC. Brief summaries of the discussions within the SC are given below.

Integrity of Transition Weldments and Cast Elbows. The status of two additional proposals being developed by the French participants (EdF, CEA and Framatome) was discussed by C. Faidy, EdF. These two proposals are concerned with the integrity of (1) cast stainless steel elbows and (2) transition (i.e., ferritic/austenitic or bimetallic) weldments. Faidy indicated that uncertainty still exists concerning the possibility of developing these two topics into NESC projects. He agreed to provide additional information on the proposals at the upcoming SC meeting in Rome.

Corrosion. S. Crutzen, JRC, provided a brief progress report on the NESC corrosion proposal that was originally introduce at the Stockholm meeting. He indicated that a current need is to find financing for the project, and that reactor safety may not be a viable option for pursuing financing. These and other matters concerning the corrosion proposal will be discussed at a meeting to be held in Petten on March 14, 1995.

Defect Assessment Procedures for European Industry. This proposal is concerned with verification of standardized structural integrity assessment procedures applicable to all (non-nuclear) industrial sectors. In a very brief update, the SC chairman indicated that this proposal is moving ahead and that more details will be provided at the next SC meeting in Rome.

Meeting Schedule

Future meetings of the SC were tentatively scheduled as follows:

Location	Date	Host
Rome, Italy	September 20-22, 1995	ANPA
Petten, Netherlands	March 1996	JRC/IAM

Meetings of the TGs will be held prior to the meetings of the SC according to a schedule to be announced at a later date.

3. Phase II of CSNI/FAG Project FALSIRE

At GRS, Köln, Germany, traveler participated in meetings of the OC for Phase II of the CSNI/FAG Project FALSIRE. [The OC consists of H. Schulz, J. Sievers (GRS) and the traveler.] Discussions focussed on evaluating additional information and analysis results submitted by testing organizations and participants and on developing an outline for the final report on FALSIRE II. New proposals for future CSNI/FAG activities related to reactor safety assessments were also discussed.

3.1 Background

Project FALSIRE is sponsored by the FAG of CSNI/PWG-3. On behalf of the CSNI/FAG, ORNL and the GRS, Köln, Germany, have responsibility for organizational arrangements related to Project FALSIRE. (The chairman of the CSNI/FAG is H. Schulz of GRS.) The CSNI/FAG was formed to evaluate fracture prediction capabilities currently used in safety assessments of nuclear components. Members are from laboratories and research organizations in Western Europe, Japan, and the United States. The CSNI/FAG completed Phase I of FALSIRE, which assessed various fracture methodologies through interpretive analyses of selected large-scale fracture experiments [3]. The six experiments used in FALSIRE I (performed in Germany, Japan, United Kingdom, and the United States) were designed to examine various aspects of ductile crack growth in RPV steels under PTS loading.

It was proposed in Ref. 3 that a follow-on Phase II program (FALSIRE II) should emphasize experiments that focus on behavior in the transition temperature region of relatively shallow cracks subjected to combined thermal and mechanical loading. Investigations of crack extension in connection with clad surfaces should also be included.

3.2 FALSIRE Phase II

The action plan developed by the OC for FALSIRE II is summarized in Table 4. In September 1993, the OC of the CSNI/FAG completed the preparation of comprehensive problem statements for a set of experiments proposed by testing organizations in France,

Table 4. Schedule of events for Phase II CSNI/FAG Project FALSIRE

November 1993	OC distributes problem statements and participant response form
February 1994	Participants submit response forms to OC
April 1994	OC distributes 1-page reminder concerning submission of structural analysis results from participants
May 1994	Participants submit summaries of structural analysis results to OC
May 1994	OC meets to review (1) progress in Phase II, and (2) structural analysis results submitted by participants
June 1994	Participants submit summaries of fracture mechanics assessment to OC
August 1994	OC completes development of evaluation programs FEDIT/FPLOT
October 1994	OC compiles analysis results submitted electronically by participating analysts
November 8-10, 1994	OC hosts Phase II FALSIRE Workshop for participating analysts in Atlanta, Georgia
March 1995	Participants submit additional data and analysis results to OC (action items)
May 1995	OC meets to review progress in preparation of final report and to discuss future work of CSNI/FAG
November 1995	OC submits draft final report for reviews
December 1995	OC completes final report
Spring 1996	OC submits final report to CSNI/PWG-3
Spring 1996	Publication of final reports - ORNL/NRC (NUREG); GRS/CSNI

Germany, Russia/Finland, United Kingdom, and the United States. The primary focus of the experiments (see Table 5) was on the behavior of relatively shallow cracks under PTS loading in the transition temperature region; effects of biaxial loading and effects of cladding on cleavage fracture were studied separately in two sets of experiments. The OC commenced distribution of these problem statements in November 1993 to analysts who had previously indicated a willingness to participate in FALSIRE II.

Participants were requested to provide summaries of structural analysis results to the OC in April 1994. The submitted results were reviewed and assessed by the OC during scheduled May 1994 working sessions held at GRS. The primary purpose of this evaluation was to ensure that proper modeling of structural response was being achieved by analysts prior to performing fracture assessments of the reference experiments.

Table 5. Large-scale reference fracture experiments proposed for FALSIRE II

Experiment	Organization	Testing Country
Thick cylinder; thermal/centrifugal load (SC-4)	AEA Technology, Risley	U. K.
Thick cylinder; thermal/pressure load (PTS I/6)	Central Research Institute of Structural Mechanics (Prometey)[a]	Russia
	Technical Research Center of Finland (VTT)[b]	Finland
Clad beam; isothermal/uniaxial bend load (DD2/DSR3)	Electricité de France (EdF)	France
Thick cylinder; thermal/pressure/ tension load (NKS-5)	MPA, Universität Stuttgart	Germany
Thick cylinder; thermal/pressure/ tension load (NKS-5)	MPA, Universität Stuttgart	Germany
Cruciform beam; isothermal/ biaxial bend load (BB-4)	ORNL	U. S. A.

[a]Organization performing test.

[b]Organization performing analysis.

Documentation describing final results from fracture mechanics assessments of the reference experiments was requested from the participants starting at the end of June 1994. Analysts were asked to transmit their results electronically to GRS, where a special-purpose computer program was developed to organize the analyses into a comparative data base. This data base also includes selected portions of the measured data generated in the six reference experiments. Summaries were generated from the data base for use in the FALSIRE II Workshop.

The FALSIRE II Workshop was held during November 8-10, 1994, at the Terrace Garden Hotel in Atlanta, Georgia. Over 30 participants representing 22 organizations from 12 countries took part in the Workshop that focused on analyses of the reference fracture experiments; the organizations participating in the Workshop are given in Fig. 5. Final results for 43 analyses of the reference experiments were received by the OC from the participating analysts.

The OC opened the Workshop by providing an overview of the objectives of the CSNI-FAG, the format used in the Workshop program, and a summary of recent activities within FALSIRE II. Comparative summaries prepared from analyses of the reference experiments performed by participants were discussed in detail during the Workshop. Also, for each reference experiment, a panel assembled from the group of participating analysts who contributed solutions to that experiment provided additional detailed information concerning the analyses. An extensive list of preliminary results, conclusions and action items were compiled for each of the experiments as a result of these discussions. These preliminary results and conclusions were summarized in the official minutes of the Workshop by the OC and transmitted by FAX to participants in mid-December 1994.

3.3 Supplemental Information and Results

At the FALSIRE II Workshop, an extensive list of action items was compiled for each of the reference experiments to resolve outstanding issues raised in discussions of the experimental and analytical results. After the Workshop was concluded, the OC prepared

Twenty-Two Organizations from Twelve Countries Contributed Experiments and Analyses to the FALSIRE II Project

Organization	Country
AEA Technology	UK
Bhabha Atomic Research Center (BARC)	India
Centre D'Etudes Nuclearies de Saclay (CEA)	France
Engineering Center of Nuclear Equipment Strength, Reliability & Lifetime (ECS)	Russia
Electricité de France (EdF)	France
FMC Corporation	USA
Framatome	France
Fraunhofer Institut für Werkstoffmechanik (IWM)	Germany
Gesellschaft für Anlagen-und Reaktorsicherheit (GRS)	Germany
Institute for Problems of Strength (IPS)	Ukraine
Kurchatov Institute	Russia
Nuclear Electric (NE)	UK
Onsala Inqenjorsbyra	Sweden
Oak Ridge National Laboratory (ORNL)	USA
Paul Scherrer Institut (PSI)	Switzerland
Central Research Institute of Structural Mechanics (Prometey)	Russia
Materialprüfungsanstalt (MPA) der Universität Stuttgart	Germany
Technical Research Center (VTT)	Finland
Siemens (KWU)	Germany
University of Maryland	USA
University of Pisa	Italy
University of Tokyo	Japan

Fig. 5 Participation in CSNI/FAG-FALSIRE II Project organized by GRS and ORNL

and distributed detailed requests for supplemental information and analysis results to be provided by the testing organizations and the participating analysts.

Thus far, ten organizations have provided a response to the requests from the OC. At Köln, the data received from these organizations were reviewed by the OC and incorporated into the FALSIRE II data base being compiled for the reference experiments. Also, evaluations were made concerning the impact of these data on completion of the list of action items drafted during the Workshop. A majority of these action items have been addressed in the responses received from the participants. Additional data will be received in the near future from several participating organizations that have not yet responded. These data will also be included into the final assessment of the analysis results.

3.4 Preparation of Final Report

A draft final report on the FALSIRE II Project is being prepared by the OC. During discussions at Köln, the OC developed a revised outline for the report and allocated writing assignments for the various chapters of the report among the members of the OC. Also, a preliminary assessment of the number and type of comparative summary plots to be included in the report for each experiment was completed. It is anticipated that a draft final report will be submitted to CSNI/FAG for review in November 1995.

3.5 Follow-on Program for CSNI/FAG

Recently, the CSNI/FAG has received inquiries from several European research organizations requesting information on CSNI/FAG plans for future programs that would follow Project FALSIRE. To address these inquiries in a timely manner, the OC held discussions at Köln concerning proposals for two follow-on activities within CSNI/FAG that would address structural integrity issues. These proposals are given as follows:

- Compilation of measured data and analysis results for international thermal-shock experiments into a data bank system (including those tests not covered in FALSIRE I and II);

- Organization of a benchmark analysis program for a full-scope cladded RPV under transient thermo-mechanical loading with postulated cracks of different sizes and in different locations.

The discussions at Köln were focussed primarily on the proposal for the benchmark RPV analysis program. It was agreed that a "call for participation" in the benchmark analysis program will be developed in March 1995 and then issued in the form of a newsletter from CSNI/FAG to Project FALSIRE participants and to other interested parties. A more detailed problem statement on the analysis program will be prepared in May 1995. GRS, in cooperation with ORNL, will define the RPV geometry, the crack depths and configurations, the material properties, the transient loading conditions, and the reporting conditions. It is anticipated that the benchmark analysis program would be carried out in CY 1996.

Several questions remain to be resolved before the benchmark analysis program can be formally adopted and launched by CSNI/FAG. These include determining the level of support for the project that could be anticipated from (1) the national governmental and regulatory organizations that sponsor participation of GRS and ORNL in CSNI/FAG; (2) the CSNI/PWG-3; and (3) the international technical organizations that have supported FALSIRE. The CSNI/FAG will be working to resolve these questions in the near future.

4. References

1. S. McAllister and S. Bhandari, "NESC Spinning Cylinder Experiment: Pre-Test Structural Analysis Evaluation," ASME Pressure Vessel and Piping Conference, Honolulu, Hawaii, July 1995, to be published.

2. J. A. Keeney, Martin Marietta Energy Systems, Inc., Oak Ridge National Lab., "Analyses of Multiple Cracks in the NESC-1 Spinning Cylinder Experiment," USNRC Letter Report ORNL/NRC/LTR-94/35, December 30, 1994.

3. B. R. Bass, C. E. Pugh, J. Keeney-Walker, H. Schulz, and J. Sievers, Martin Marietta Energy Systems, Inc., Oak Ridge National Lab., *CSNI Project for Fracture Analysis of Large-Scale International Reference Experiments (Project FALSIRE)*, NUREG/CR-5997 (ORNL/TM-12307), June 1993.

APPENDIX A

ITINERARY

March 5-6	Travel	Knoxville, TN to Köln, Germany
March [illegible]-8	Meetings Organizing Committee FALSIRE II	GRS Köln, Germany
March 9	Meeting NESC Evaluations Task Group (TG5)	GRS Köln, Germany
March 9-10	Meetings NESC Steering Committee	GRS Köln, Germany
March [illegible]1-12	Weekend	Köln, Germany
March [illegible] 14	Vacation	Köln, Germany
	(NOTE: all expenses resulting from traveler's stay in Germany during 3/11-14/95 borne by traveler with no additional cost incurred by NRC)	
March 15	Travel	Köln, Germany to Knoxville, TN

APPENDIX B

LIST OF ATTENDEES

KÖLN, GERMANY

NESC TG5 Meeting - March 9, 1995

Name	Organization
R. Bass	ORNL
S. Bhandari	Framatome
S. Crutzen	JRC
U. von Estorff	JRC/IAM
J. Hedderly	JRC
B. Hemsworth	HSE
R. Hurst	JRC
H. Kockelmann	MPA
R. Murgatroyd	AEA
R. Rintamaa	VTT
H. Schulz	GRS
J. Sievers	GRS
J. Wintle	AEA Technology

APPENDIX B (Continued)

NESC Steering Committee Meeting - March 9-10, 1995

Name	Organization
G. Airey	NE
R. Bass	ORNL
S. Bhandari	Framatome
F. Boydon	HSE-NII
B. Bröcker	Preussen Elektra
S. Crutzen	JRC
J. Devos	CEA
C. Faidy	EdF-Septen
J. Hedderly	JRC
B. Hemsworth	HSE
R. Hurst	JRC
G. Karzov	CRISM (Prometey)
H. Kockelmann	MPA
D. Lacey	HSE
D. Lidbury	AEA
D. Mignot	AVN
R. Murgatroyd	AEA
G. Nagel	Preussen Elektra
R. Palframan	Rolls-Royce
A. Pini	ANPA
R. Rintamaa	VTT
H. Schulz	GRS
J. Sievers	GRS
S. Sturm	MPA
B. Timofeev	CRISM (Prometey)
K. Törrönen	VTT
C. Townley	NE
U. von Estorff	JRC/IAM
J. Wintle	AEA Technology

APPENDIX C

AGENDA FOR NESC TG5 MEETING

KÖLN, GERMANY

March 9, 1995

1. Opening and welcome
2. Approval of Minutes of last meeting held on 7th September, 1994, Stockholm
3. Matters arising from the Minutes
4. Reports from Task Group Chairmen
5. Evaluation of results and recommendation of actions for Task Groups, Project Manager, Network Manager and Reference Library
6. Formulation of recommendations and requests for decisions to NESC Steering Committee
7. Any other business

APPENDIX D

AGENDA FOR STEERING COMMITTEE MEETING

KÖLN, GERMANY

March 9-10, 1995

NESC DOC (95) 13

1. Welcome and opening of the meeting
2. Adoption of the agenda
3. Minutes of the last meeting held in Stockholm/Helsinki, 7-8 September 1994, [NESC DOC SC (94) 12]
4. Actions arising from the minutes
5. Network Management Report
6. NESC-1 Project
    6.1 Project Manager's Report
    6.2 Task Group Chairmen Reports
    6.3 Approval of Actions Proposed
7. NESC 2 Project (with CRISM Prometey)
    7.1 NESC 2 Proposal
    7.2 Recommendation of Action
8. Future NESC Projects
    8.1 Integrity of Transition Weldments
    8.2 Integrity of Cast Elbows
    8.3 Corrosion
    8.4 Defect Assessment Procedures for European Industry
9. Any other business
10. Date of next meeting

APPENDIX E
STEERING COMMITTEE MEMBERSHIP

KÖLN, GERMANY

March 9-10, 1995

<u>OFFICERS</u>

CHAIRMAN:	B. Hemsworth	NII
VICE-CHAIRMEN:	H. Schulz*	GRS
	R. Bass*	ORNL
NETWORK MANAGER:	R. Hurst	JRC
PROJECT MANAGER:	J. Wintle	AEA

<u>MEMBERS</u>

D. Acker*	CEA
G. Airey*	NE
F. Boydon*	HSE
S. Bhandari*	Framatome
G. Bollini*	Tecnatom
Dr. Bröcker*	Preussen Elektra
C. Faidy*	EdF
G. Hedner*	SKI
K. Kussmaul*	MPA
D. Lidbury	AEA
P. Mignot*	AIB-Vincotte
R. Palframan	Rolls-Royce
G. Piccini*	ENEL
A. Pini*	ANPA
K. Törrönen*	VTT

*Indicates Voting Member

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4. Director of International Programs, NRC, Washington, DC 20555-0001
5. L. C. Shao, Director, Division of Engineering Technology, RES, Nuclear Regulatory Commission, Washington, DC 20555-0001
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7-8. M. E. Mayfield, Division of Engineering Technology, RES, Nuclear Regulatory Commission, Washington, DC 20555-0001

9. S. N. M. Malik, Division of Engineering Technology, RES, Nuclear Regulatory Commission, Washington, DC 20555-0001
10. J. R. Strosnider, Materials and Chemical Engineering Branch, NRR, Nuclear Regulatory Commission, Washington, DC 20555-0001
11. M. Vagins, Division of Engineering Technology, RES, Nuclear Regulatory Commission, Washington, DC 20555-0001
12. R. O. Hultgren, ORNL Site Manager, DOE, ORNL, P. O. Box 2008, Oak Ridge, TN 37831-6269
13. W. G. Phelps, Director, Safeguards and Security Division, DOE-ORO, P. O. Box 2001, Oak Ridge, TN 37831-8571
14. S. R. Martin, DOE-ORO, Oak Ridge, TN 37831-6269
15. D. Morrison, P. O. Box 567254, Atlanta, GA 31156

16-18. Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831

19-24. B. R. Bass

25. W. R. Corwin
26. T. L. Dickson
27. R. G. Gilliland
28. W. H. Hayden, Jr.
29. D. M. Hetrick
30. J. A. Keeney
31. M. A. Kuliasha
32. W. J. McAfee
33. D. E. McCabe
34. J. G. Merkle
35. R. K. Nanstad
36. J. V. Pace III
37. W. E. Pennell

38-40. C. E. Pugh

41. J. O. Steigler
42. A. W. Trivelpiece
43. Laboratory Records Department
44. Laboratory Records Dept. - RC
45. Laboratory Protection Division
46. ORNL Foreign Travel Office
47. ORNL Patent Office