MINUTES OF THE THIRD MEETING OF THE PROGRAMME’S WORKING GROUP 1 ON IMPROVEMENTS IN IN-SERVICE INSPECTION PERFORMANCE AND QUALIFICATION

VNIIAES, MOSCOW, RUSSIA
MAY 22-24 2001

EXTRABUDGETARY PROGRAMME ON MITIGATION OF INTERGRANULAR STRESS CORROSION CRACKING IN RBMK REACTORS

INTERNATIONAL ATOMIC ENERGY AGENCY
1. INTRODUCTION

The third meeting of Working Group 1 on Improvements in In-Service Inspection Performance and Qualification was held at VNIIAES Moscow, Russia, 22-24 May, 2001. The objective of the meeting was to review the progress of the Working Group against the project plan and schedule that was agreed to during the first meeting in July 2000 at Kursk plant, respectively adjusted in February 2001 in Kiev as well as to review the first draft qualification document. The meeting achieved its objective and the participants agreed to complete development of the qualification document and conduct of a pilot study of the qualification process on a sizing procedure that has been adapted from western technology by Ignalina plant staff.

A list of meeting participants is provided in Appendix I. A summary of the meeting is provided below.

2. MEETING SUMMARY

T. Taylor opened the meeting and asked that the new participants who attended the Working Group 1 meeting introduce themselves. R. Havel then provided an overview of the progress of the whole IAEA Extrabudgetary Programme on Mitigation of Intergranular Stress Corrosion Cracking in RBMK Reactors. After R. Havel’s overview, the Working Group members adopted the meeting minutes from the second Working Group meeting and agreed to the following specific agenda items.

– review the initial draft of the qualification document;
– discuss specific logistics and details for the Workshop on Automated ultrasonic inspection offered by Tecnatom;
– agree upon specific action items necessary to complete the objectives of the Working Group 1.

2.1. REVIEW OF THE INITIAL DRAFT OF THE QUALIFICATION DOCUMENT

Western participants from Working Group 1 developed a qualification document based upon performance demonstration practices that have been developed in Europe through ENIQ, in the United Kingdom through validation trials and in the United States through the American Society for Mechanical Engineers (ASME) Section XI and the Performance Demonstration Initiative managed by the Electric Power Research Institute. The topical outline found in IAEA report Qualification of In-Service Inspection systems for WWER Nuclear Power Plants, was used as a basis for the qualification document.

The draft qualification document is too large to be included in these meeting minutes, however, a copy of the draft document may be obtained by submitting a written request to the Working Group Leader, T. Taylor or R. Havel. The qualification document contains the following sections:
1.0. Introduction

During discussion of the introduction Working Group members decided that the scope of the qualification document would cover only the defect through wall sizing procedure adapted by the staff at Ignalina nuclear power plant.

2.0. Technical Specification

The technical specification covers the following topics.

– Code Requirements
– Component Addressed by Qualification
– NDT Methods
– Inspection Conditions
– Flaw Parameters to be measured
– Inspection Effectives
– QA Requirements

I. Korobskaya provided a list of the Russian codes and quality assurance documents. During discussion of the technical specification, members of the Working Group decided that it was not necessary to include a list of code requirements from Lithuania or Ukraine as the code requirements of both of these countries are reflected in Russian code requirements.

3.0. Inspection Procedure

During discussion of the inspection procedures that will be covered by the qualification document, Lithuania requested that the Working Group reconsider qualification of the detection procedure MCU – 5 – 99. After a very heated discussion the Working Group decided that the qualification document would only describe requirements for the sizing procedure. So references to MCU –5 – 99 will be deleted.

During discussion of the adaptation of inspection procedures, NIKIET via A. Petrov, made a commitment to adapt the weld overlay inspection procedure. T. Taylor agreed to provide comments on the adapted weld overlay procedure that NIKIET developed.
4.0. Qualification Procedure

The qualification procedure contains three sections; a Technical Justification, a Description of the Practical Trials and the Evaluation criteria. B. Dikstra from Mitsui Babcock Technology developed the draft of the technical justification. He was however, unable to attend the meeting due to prior business commitments. J. Thompson attended the meeting instead for B. Dikstra and led the Working Group through a discussion of the qualification document, Appendix II.

During discussion of the Technical Justification the Working Group provided significant input to the document. The agreements of the Working Group are too numerous to be listed in these minutes. Members of the Working Group agreed to provide input for a second revision of the Technical Justification by July 31st. Several notable technical agreements reached at the meeting are listed below:

- The target crack size covered by the technical justification is a defect 4mm in through wall extent and 60mm in circumferential length.
- The through wall extent sizing tolerance agreed to at the meeting was +/- 2.5mm
- The length sizing tolerance agreed to at the meeting was +/- 15mm
- It was agreed that the experiment design of trials should include provisions for restricted assess for some samples.

5.0. Evaluation Criteria

During discussion of the evaluation criteria for the qualification process the Working Group reached the following agreements:

- NIKIET would provide information for how many sizing measurements are necessary under Russian regulations
- The process used in the trials for sizing would require the following steps:

  1. first the candidate would find the crack ends
  2. the next candidate would find the deepest part of the crack
  3. finally the candidate would profile the crack in 15mm increments

For depth sizing the Working Group agreed that the samples used in the qualification would be grouped into three ranges:

- 5 – 30% through wall
- 31 – 50% through wall
- greater than 50% through wall

For length sizing the Working Group agreed that the samples used in the qualification would be group into the following ranges:

- less than 40mm in length
- 40mm to 80mm length
- 80mm or greater in length
In closing discussion on the qualification document, the Working Group agreed to conduct the pilot study for sizing starting in October 2001. Since the scope of procedures in the pilot study is reduced to one; the sizing procedure adapted by Ignalina, the pilot study will still be completed on schedule.

2.2. ORGANIZATION OF WORKSHOP AT TECNATOM

The Working Group discussed logistics and details for the workshop on Automatic Ultrasonic Inspection proposed by Tecnatom. The major points of discussion are provided below:

The Working Group agreed with the written objective and training syllabus provided by J. Sanchez. J. Sanchez was unable to attend the meeting and J. Pelaez attended the meeting on his behalf instead.

The Working Group agreed to the following participants for the workshop:

– Lithuania: Y. Saburov
– Russia: I. Korbskaya
– Kursk: A. I. Miasniankin
– Leningrad: V. Bykov
– Smolensk: P. Nikishov
– Ukraine: V. Zinchenko
– NIKIET: N. Timofeev

The Working Group agreed to that the workshop would be held July 2 to 6th at Tecnatom’s facilities in Madrid, Spain.

3. ACTION ITEMS AND COMMITMENTS OF WG 1 MEMBERS

The Working Group Members and participants at the meeting made the following commitments and agreed to the following action items:

Entire Working Group

– Review the Qualification document and provide any comments to T. Taylor and B. Dikstra by July 15th. (See the individual list below for specific member commitments).

– Review Working Group 1 meeting minutes and provide comments to R. Havel as soon as practical.
Y. Saburov
- Ignalina will be conducting a trial of the sizing procedure and Y. Saburov agreed to
determine if the results could be made available to Working Group members

N. Timofeev
- Provide input as requested by B. Dikstra to the draft Technical Justification by July
  1\textsuperscript{st}. Adapt the weld overlay procedure by December 2001.

I. Kadenko
- Provide a written section on evaluation of qualification results that will be included in the
  qualification document by July 1\textsuperscript{st}.

S. Kostenko
- Assist I. Kadenko in writing the section on evaluation of qualification results.

B. Dikstra
- Incorporate input from working group members into the draft of the Technical
  Justification by July 31\textsuperscript{st}.

T. Taylor
- Develop the draft meeting minutes by June 18\textsuperscript{th}
- Develop a proposal with R. Havel for a meeting site for the next working group meeting

M. Trelinski
- Update the Tables in the Section of the Technical Justification by June 15\textsuperscript{th}

R. Havel
- Work with Tecnatom on logistics for the seminar on automated UT

The next meeting of Working Group 1 is scheduled for April 9 to 11\textsuperscript{th} 2002. The group
could not agree on a site for the next meeting so T. Taylor and R. Havel will develop a
proposal by October 2001.
Appendix I

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Appendix II.

PRESENTATION ON TECHNICAL JUSTIFICATION
Technical Justification

Pilot qualification
Ignalina sizing procedure
May 2001
Procedure addressed

- “Sizing of flaws such as IGSCC detected in the heat-affected zone of welds on 300-mm diameter austenitic piping of the Main Coolant Circuit “

As submitted by Juri Saburov to Wk Gp 2
T J Structure

Follows ENIQ scheme:
- §1 Introduction
- §2 Input information
- §3 Overview of inspection
- §4 Analysis of Influential Parameters
- §5 Physical reasoning
(cont.)
T J Structure (cont.)

- §6 Theoretical modelling
- §7 Parametric studies
- §8 Experimental evidence
- §9 Effect of tolerances in essential variables
- §10 Review of evidence
- §11 Conclusions
§1 Introduction

• Defines scope
• States that aim is to follow:
  – ENIQ Recommended practice no. 2
    Recommended contents for a TJ
  – ENIQ Recommended practice no. 3
    Strategy document for a TJ
§2 Input information

- Component data
- Target defects
- Defect sizing tolerances
Note TJ scope is restricted (for draft) to straight-pipe configuration with access at same side of defect
Component data

- Some differences identified between information from UT procedure and from NIKIET VTT paper

Need to clarify:
(Differences may be plant specific)
Ignalina procedure
Target defects

- Target size is the defect size for which sizing performance is to be qualified

(Does not rule out sizing smaller defects – but TJ does not attempt to qualify performance for smaller defects)

- Length 60 mm  Height 4 mm

(as agreed at Kiev meeting)
Sizing performance

- Propose length sizing tolerance:
  \(+/-\ 15\ \text{mm}\)

- Propose height sizing tolerance:
  \(+/-\ 2.5\ \text{mm}\)

*(don’t think tolerances were fixed at Kiev meeting – needs input from other working groups)*
§3 Overview

- Describes equipment
  
  Background information required on equipment checking procedures
- Describes personnel requirements
  
  Given specialised techniques, there may be a need to define requirements in more detail (e.g. ref. to a training syllabus)
Techniques described:

- **30-70-70 technique for determining best sizing technique**
  - **TOF:** RATT/AATT \( h < 30\% t \)
  - **MOST:** \( \tau / \sigma \) \( 30\% t < h < 60\% t \)
  - **HALT:** \( 70^\circ / \text{creep} \) \( h > 60\% t \)
30-70-70 technique

TJ assumes recommended transducer is used:
- Krautkramer WSY 4
§ 4 Essential variables

- ENIQ classification of variables made

Some discussion will be necessary to fix tolerances on equipment parameters:
(e.g. transducer beam angle)
§5 Physical reasoning

- Provides explanation of why techniques have been selected
- Provides justification of why techniques are believed to be effective

Example: justification of the 30-70-70 method for selecting the sizing technique
Overall sizing strategy (procedure fig. 8)

30-70-70 Method

- Only CE-2 on a screen
  - Height up to 15%

- CE-2 and CE-1 on a screen
  - Height till 15-30% (on width waveform envelope)

- CE-2 and CE-1 on a screen
  - Height till 30-50% (on width waveform envelope)

- CE-2, CE-1 and 70L on a screen
  - Height more than 50%

RATT TOF method

- If weld crown width allows
  - AATT TOF method

- Measurement

SIGMA MOST method

- If weld crown width allows
  - Tau MOST method

- Measurement

HALT method

- Measurement

THE REPORT

Mitsui Babcock
Selecting sizing technique

- Where size measurement shows defect is outwith techniques best range, defect is sized again by best technique

- *Hence the 30-70-70 technique does not need to be 100% effective*
Interpretation of results of 30-70-70 – proc. Fig 4

30-70-70 method

- Probably, very high flaw
- Probably, flaw height more than 50% 
- Probably, flaw height less than 50% 
- Probably, flaw very shallow

A - longitudinal wave 70L
B - wave 30-70-70
C - head wave
Assumptions of 30-70-70 technique

- If creep wave signal appears, defect is surface connected – generally reasonable but:

Some discussion needed here:
Assumption may not hold if defect is tilted
(Skipped 70 beam will give signal at same range)
Identification of creep signal may be difficult if no other signal present
Assumptions of 30-70-70 technique

- If 30-70-70 signal appears then defect height > 15% t

Reasonable assumption on basis of estimated coverage zone
Defects < 15% t are not covered by detection zone
Assumptions of 30-70-70 technique

- Width of echodynamic increases for as height increases in range 30% to 60% t

*Reasonable assumption on basis of variation of height of optimum reflection point*
For large defect, signal persists over wide range of standoff - i.e. echodynamic is broad
Assumptions of 30-70-70 technique

- Defects with height > 50% t will be clearly detected at ranges less than the bi-modal signal

*Shown to be reasonable assumption by consideration of echo-ranges of the two signals*
Physical reasoning (cont.)

- Individual sizing techniques are considered in the same way
- For each technique estimates will be made of the sizing error to be expected
Example:
– the MOST technique is examined in some detail
Shear leg longitudinal beams

τ-MOST detection zone

Bi-modal detection zone B

Showing τ-MOST detection zone + one bimodal zone
Shear leg

longitudinal beams

τ-MOST detection zone

Bi-modal detection zone A

Showing tau MOST detection zone + other bimodal zone
§6 – 11 Remainder of TJ

- These sections still to be produced

- *Input required from others, particularly on experimental evidence for the effectiveness of the techniques*  
  *(data from US BWR programme?)*