



**International Atomic Energy Agency**

# Update and upgrade of IAEA-TECDOC on Ageing Management of Steam Generators

**Ludovit Kupca**

Nuclear Power Division

IAEA, Vienna, 15-18 June 2009

# Invited Experts

- **Canada**  
Jovica Riznic, Canadian Nuclear Safety Commission
- **China**  
Liu Hongyun, China Nuclear Power Operation Technology Corporation
- **Germany**  
Fernando Roumiguiere, AREVA NP GmbH
- **Korea**  
Seong Sik Hwang, Korea Atomic Energy Research Institute
- **Slovakia**  
Martin Březina, VUJE Inc.
  
- **Scientific Secretary**  
Ludovit Kupca, Nuclear Power Division;
- **IAEA**  
Ki Sig Kang, Richard Shouler - Nuclear Power Division



# Objectives of Meeting

- To collect national experiences
- To develop the extended outline of an updated technical document
- To plan further activities to develop a technical document.

# Objectives of Meeting

- To agree the format of the updated / upgraded IAEA-TECDOC on Ageing Management of Steam Generators using the latest knowledge and experience from BWR/PWR/WWER/CANDU type of nuclear power plants.
- To develop **Table of Contents** and extended outline of updated IAEA-TECDOC publication.
- To agree on strategy / time frame / workplan for preparation of updated IAEA-TECDOC publication on Ageing Management of Steam Generators.

# Schedule of Meeting

- Introductions; Programme and objectives of the meeting
- Presentation of country's approach to Steam Generator Ageing Management - current practices and related issues
- Discussion on strategy for Drafting of updated IAEA publication on Management of Ageing of Steam Generators
- Review/comment to each chapter of existing IAEA-TECDOC-981; Drafting modified/new **Table of Contents** of updated IAEA publication
- Discussion on assignments/homework to each expert on development of particular chapters of an updated IAEA publication
- Conclusions / recommendations for future work - discussion on deadlines to prepare the draft working material for the next Consultancy Meeting preliminarily scheduled for November 2009
- Final conclusions and actions for CS2

# TECDOC-981: Table of Contents

## **1. INTRODUCTION**

- 1.1. Background
- 1.2. Objective
- 1.3. Scope
- 1.4. Structure

## **2. STEAM GENERATOR DESCRIPTIONS**

- 2.1. PWR recirculating steam generators
- 2.2. CANDU recirculating steam generators
- 2.3. PWR once-through steam generators
- 2.4. WWER steam generators

## **3. STEAM GENERATOR DESIGN BASIS, FABRICATION AND MATERIALS ....**

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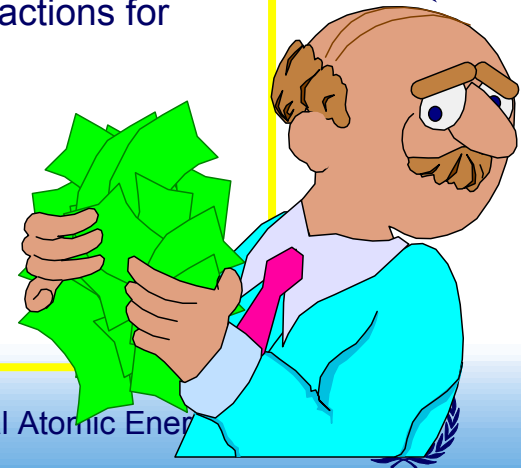
- 4. SG DEGRADATION MECHANISMS**
- 5. SG AGEING MANAGEMENT: OPERATIONAL GUIDELINES**
- 6. SG INSPECTION AND MONITORING REQUIREMENTS AND TECHNOLOGIES**
- 7. SG ASSESSMENT METHODS AND FITNESS FOR SERVICE GUIDELINES**
- 8. SG MAINTENANCE: MITIGATION, REPAIR AND REPLACEMENT**
- 9. SG AGEING MANAGEMENT PROGRAMME**

# Meeting Schedule

- June 15: presentation of national experiences and discussion to set-up outline:
  - Present the information about meeting
  - Presentation of the practices of each country: Canada, China, Germany, Korea, Slovakia
  - Discuss strategy for drafting of an updated IAEA publication on Ageing Management of Steam Generators
- June 16: Prepare technical contents
  - Prepare Table of Contents for topics to be developed
  - Review each chapter of TECDOC-981 and identify needs for update / modification / removal / development of given / missing / relevant information to reflect the current state-of-the-art in related and content

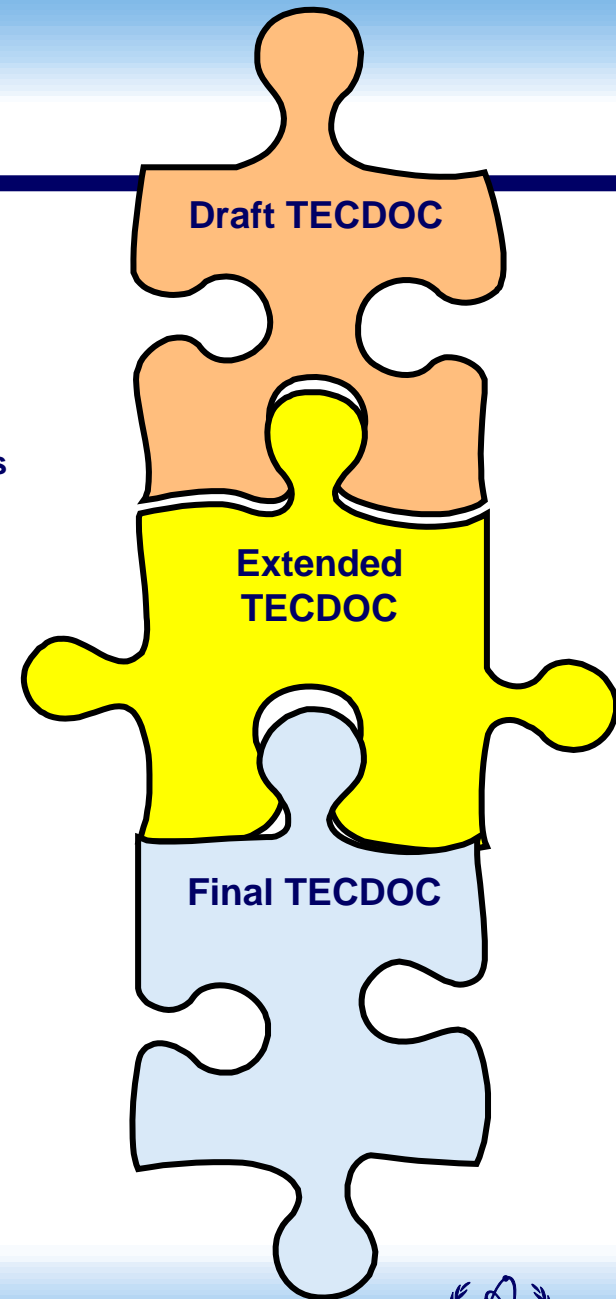
- June 17: TOC Update
  - Present the summary of each chapter
  - Working matrix ad discussion
  - Assignments/homework for preparation of each responsible chapter
- June 18: Future activities,
  - Discuss future activities / actions
  - Final conclusions and actions for CS2 Nov 2009
  - Fixing the date of CS2

*Think about  
TECDOC.*



# Activities

- **First Consultancy Meeting**
  - Date : 15-18 June at VIC
  - Invited experts : Canada, China, Germany, Korea, Slovakia,
  - Purpose :
    - Prepare draft material for update of TECDOC-981: **Assessment and management of ageing of major nuclear power plant components important to safety: Steam generators**
- **Second Consultancy Meeting**
  - Date : November 2009 at VIC
  - Invited experts : 4~5 experts
  - Purpose :
    - Share and exchange information.
    - Prepare the extended TECDOC.
- **Third Consultancy Meeting**
  - Date : 2Q 2010
  - Invited experts : 4~5 experts
  - Purpose :
    - Finalize TECDOC



# Hot issues in Current Operating Npps

## Most Attractive Tools for NPP

- Plant life management for beyond design life operation
  - 30 ~ 40 year -> 20 Years extension
  - LTO
- Power uprate
- Safety upgrading / modernization of NPP

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- 2.1. PWR recirculating steam generators
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- 2.3. PWR once-through steam generators
- 2.4. WWER steam generators

## 3. STEAM GENERATOR DESIGN BASIS, FABRICATION AND MATERIALS ....

- 3.1. Codes and specifications
- 3.2. Fabrication and materials
  - 3.2.1. Heat exchanger tubes
  - 3.2.2. Tube installation in the tubesheet
  - 3.2.3. Tube supports
  - 3.2.4. Feedwater nozzle and shell

# TECDOC-981: Table of Contents

## **5. STEAM GENERATOR AGEING MANAGEMENT: OPERATIONAL GUIDELINES**

- 5.1. Primary coolant system water chemistry control parameters
- 5.2. Secondary coolant system water chemistry control parameters
- 5.3. Measures to control secondary-side chemical impurity incursions
- 5.4. Measures to remove secondary-side impurities
- 5.5. Measures to control steam generator deposits

## **6. STEAM GENERATOR INSPECTION AND MONITORING REQUIREMENTS AND TECHNOLOGIES**

- 6.1. Tubing inspection requirements
- 6.2. Tubing inspection techniques
- 6.3. Monitoring leakage from tubing
- 6.4. Feedwater nozzle inspection
- 6.5. Monitoring fatigue damage to feedwater nozzles

# TECDOC-981: Table of Contents

## 4. STEAM GENERATOR DEGRADATION MECHANISMS

- 4.1. PWR and CANDU recirculating steam generator tubes
- 4.2. PWR once-through steam generator tubes intergranular attack
- 4.3. WWER steam generator tubes
- 4.4. Tube rupture events
- 4.5. PWR and CANDU steam generator shell, feedwater nozzle and tubesheet
- 4.6. WWER collector, shell, and feedwater distribution system
- 4.7. Summary of current world experience

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## 7. STEAM GENERATOR ASSESSMENT METHODS AND FITNESS FOR SERVICE GUIDELINES

- 7.1. Tubing repair criteria
- 7.2. Tubing fitness-for-service guidelines in various countries
- 7.3. Statistical methods for degradation growth assessment
- 7.4. Use of probabilistic fracture mechanics analysis to assess steam generator ageing

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## **8. STEAM GENERATOR MAINTENANCE: MITIGATION, REPAIR AND REPLACEMENT**

- 8.1. Primary-side mitigation techniques for tubes
- 8.2. Secondary-side mitigation techniques for tubes
- 8.3. Tube repair
- 8.4. Vibration control
- 8.5. Mitigation of the thermal fatigue of the feedwater nozzles and piping
- 8.6. Repair of feedwater nozzles and piping
- 8.7. Steam generator replacement

## **9. STEAM GENERATOR AGEING MANAGEMENT PROGRAMME**

- 9.1. Understanding steam generator ageing and feedback of operating experience
- 9.2. Definition of steam generator AMP
- 9.3. Steam generator operation
- 9.4. Inspection, monitoring and assessment