**SPECIFICATION:**

**Software for the ageing and lifetime management of nuclear power plant structures, systems and components**

# Scope

## This specification describes the requirements for a software package (hereinafter referred to as the “software”) for the ageing and lifetime management of NPP structures, systems and components, in support of TC project IRA/2/013 whose general objective is to improve and maintain the safety and reliability of the operating Bushehr-1 NPP. The software will be used by Bushehr Nuclear Power Plant (BNPP) personnel in Iran.

## Alternatives to this Specification, intended to produce the same or better results for this application, are subject to written approval of the IAEA Technical Officer.

# Definitions, Acronyms and Abbreviations

End-user Personnel of BNPP, Bushehr, Iran

FAC Flow-accelerated corrosion

ISI In-service inspection

NPP Nuclear Power Plant

SSC Structures, systems and components

# Requirements

## The software shall meet the following functional and performance requirements:

* + 1. Basic platform for plant modeling including items such as collecting data, material library and standard dimensions
    2. Ageing and lifetime management/control of system, structures and components (SSC) of NPP
    3. Flow accelerated corrosion (FAC) management/control of secondary side of NPP
    4. Technical support of the secondary circuit water chemistry especially condition monitoring of the steam generators;
    5. Optimization of ISI and maintenance program

## The software shall be capable for the following essential performances:

* + 1. Functions for NPP modeling and parameter management
* User friendly Windows based user interface
* Interactive functions for power plant modeling and parameter management
* Engineering tools and input data validation
* Element addressing and visualization of data structures
* Network compatible database interface
* Managing, printing and exporting data applying MS-Office compatible formats
  + 1. Analysis of chemical calculations in order to identify degraded SSC
* Tools for modeling the plants system design based on heat balance diagram data
* Analysis routines for computation of local oxygen concentrations, alkalizing concentrations and pH values based on a known injection rate
* Evaluation functions indicating system-related water chemistry conditions for the water- and steam
* phase at any cycle location modeled
  + 1. Residual lifetime prediction of degraded SSC
    2. Comprehensive material library (for VVERs) and standard dimensions
    3. Degradation prediction models and evaluation functions for flow-induced corrosion (FIC) analysis
* Flow-accelerated corrosion (FAC) or Erosion-corrosion
* Cavitation erosion (CA)
* Liquid droplet impingement erosion (LDI).
  + 1. Degradation prediction models for material fatigue and associated load cycle analysis
* Thermal transient fatigue
* Environmental assisted fatigue (EAF)
* Flow-induced thermal cycling fatigue
* Flow-induced thermal stratification fatigue
  + 1. Degradation Sensitivity Assessment Functions
* General corrosion, shallow pitting
* Microbiologically induced corrosion
* Stress induced corrosion cracking (IGSCC, TGSCC, Ni-SCC)
* Pitting
* Crevice corrosion
  + 1. Examination data management and equipment maintenance/ISI optimization
* Examination data input forms for examination records (UT, RT, VT, PT, etc.)
* Visualization functions to support the evaluation of UT examination readings
* Interactive evaluation of wall thickness readings (blanket method)
* Calibration functions to analyze the actual state of piping elements versus the predicted state
* Functions for extrapolating key examination results
* Examination data import interfaces
* Visual inspection data management
* Experience based equipment maintenance optimization
* Support of maintenance service documentation
* Supports the analysis of maintenance findings and operational performance.

# Training

## Supplier provides software training program/internship for users (at least 4 users) in Iran or other country (if needed)

## Issuance of qualification certificate (license) to the trained users;

## \*

# Notes on Process

## The envisaged process is:

## Suppliers are requested to quote against this Specification. IAEA selects a winning bidder and places a Purchase Order.

## Supplier contacts User, to conclude any required terms related to usage of the package (such as, if a Software Licence Agreement is required)

## Upon confirmation that the Package can be implemented, the IAEA makes the Licence Fee available for invoicing.

## If a Support Fee is also required, this becomes available for invoicing on confirmation that the Package is successfully in use by the User.

## If needed, IAEA provides facilities for training the Iranian users in the other country (for example in Vienna).

## Note that the IAEA will gain no rights to the software, we only facilitate supply to the User.

# Quality Requirements

## The package shall be produced, installed, and supported in accordance with the supplier’s ISO quality assurance system or an equivalent. The supplier shall retain documents demonstrating compliance, and provide them only if specifically requested.

## The package, prior to shipment, shall be tested for conformance with manufacturer’s performance specifications and the minimum requirements specified herein.

## The package, after installation, shall be tested by the user with remote support from the supplier, to demonstrate that the performance meets the manufacturer’s performance specifications and the minimum requirements specified herein.

## If there are additional industry-specific quality requirements, such as SILx, they may be noted here – or delete this line!

# Language and Deliverable Items

## The package itself shall present solely in English to the User

## The Supplier shall provide a complete manual and technical specifications as well as tutorials (step by step implemented case studies) in the English language, in electronic form for sharing amongst users and printing as required.

## The supplier shall provide all electronic input and executive (exe.) files for case studies.

## The supplier shall provide qualification certificate for trained users.

# Support

## The Package to be supplied with a comprehensive warranty, valid for one year from date of installation.

## Supplier to provide all Updates free of charge, and maintain support for this configuration including any ambiguity and questions of users for a minimum of ten years.

## Supplier to provide relevant Upgrades free of charge within the first year from start of use.