

RSEM QUALIFICATION OF AN ULTRASONIC INSPECTION SYSTEM FOR THE EXAMINATION OF PRIMARY PIPE BRANCH NOZZLES INNER SURFACE

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INTRODUCTION

This paper describes the qualification process, technical difficulties and solutions developed by Doosan Babcock during an exercise to develop a qualified ultrasonic inspection system, using Phased Array techniques, for the examination of a series of different geometry branch nozzles (internal wall) in the primary pipe work of PWR plant.

In April 2006 Doosan Babcock were awarded a contract from EDF to develop and qualify the inspection of Primary circuit branch nozzles. The scope of this contract included the Boron Injection (RIB) nozzles and the pressuriser expansion line (LEP) to primary pipe nozzles of the 900Mw pressuriser water reactor plant operated by EDF in France. The qualification requirement was in accordance with the RSE-M standard. This standard is the French code applicable to the in service maintenance of nuclear power plant. This joint paper by Doosan Babcock and EDF discusses the RSE-M process and the experiences of both organisations in its implementation. The paper also discusses technical problems and solutions developed by Doosan Babcock in order to meet the needs of the RSE-M process and the required qualification performance. The Phased Array approach to the qualification exercise adopted by Doosan Babcock in agreement with EDF is also discussed.

RSEM QUALIFICATION

In accordance with the *Arrêté du 10/11/99*, EDF have had an obligation to qualify the non destructive examination of main primary circuit and secondary circuit components of pressurised water reactor plant. This qualification is required in advance of the site implementation on of the NDE procedures.

This same regulation also requires the creation of a qualification body, accredited by the French accreditation committee (COFRAC). This body is called the Qualification Commission; it is composed of a group of NDE experts.

The requirements of the regulation are integral to the French nuclear maintenance code the RSE-M.

Qualification is a demonstration aimed at guaranteeing the effectiveness of the NDE procedure. Qualification is used :

- To ensure that the performance achieved meets the scope of the qualification
- To ensure that the performance meets the criteria defined in the specification in a reliable and repeatable manner

Three types of qualification are covered by the RSE-M regulations.

Conventional Qualification:	No specific defect mechanism is presumed but the qualification forms part of the « Defence in Depth » strategy adopted by EDF. General performance levels must be demonstrated.
General Qualification:	A damage mechanism within a specific area is presumed. Specific performance levels are required.
Specific Qualification:	Damage is known to have occurred within a specific area. Specific performance levels are required.

In the RSE-M system the specification is prepared by the client e.g. EDF. The qualification dossier is then prepared by the supplier, this dossier includes a series of documents including the inspection procedure, technical justification, equipment and software acceptance test procedures and reports, trials specifications and trials reports. This dossier is reviewed by the client and presented for acceptance to the qualification commission. When satisfied that the process meets the requirements of the specification, the qualification body will pronounce the qualification of the process. This pronouncement may be qualified with reservations depending on the qualification results.

QUALIFICATION PROCESS

The qualification process is based on engineering demonstrations, qualification trials, Technical Justification and modelling simulations.

Open trials are performed on representative qualification blocks with real or artificial notches, using the site examination procedure.

A Technical summary establishing the performances levels is produce and validated by the Qualification body to finalize the qualification process.

RIB / LEP BRANCH NOZZLE QUALIFICATION

This project is effectively a series of general type of qualifications currently being undertaken by Doosan Babcock. In the remainder of this presentation, specific examples from the project are used to demonstrate RSE-M process and to highlight the ways in which Doosan Babcock in partnership with EDF resolved some of the technical complexities that are typical of this type of work.

INSPECTION REQUIREMENT

The project covered the development and qualification of an ultrasonic inspection system using phased array probes, to examine the inner radius and bore region of the branch nozzles with the primary pipe. The aim of the inspection being to detect and characterise thermal fatigue cracks emanating from these regions.



Figure 1 : RIB Nozzle (1 per loop, 3 per unit)



Figure 2 : LEP nozzle (1 per unit)

In order to qualify the inspection it is necessary to specify the qualification scope or “perimeter”. This specification was prepared by EDF in advance of the inspection development.

From the specification it was evident that a wide range of factors could have an influence on the inspection performance, for example, manufacturing and design differences between nozzles, geometry of available inspection surface, the impact of the saddle effect on inspection geometry, irregular surface condition, range of defect positions, austenitic structure, presence of austenitic welds as well as difficult access considerations.

The presentation explains the Phased Array approach to the qualification exercise adopted by Doosan Babcock. It covers both the theoretical approach to inspection design, probe characterisation and the theoretical and practical methods used to assess the impact of the influential inspection parameters in order to verify performance in accordance with the requirements of the RSE-M qualification process.