Experience in Qualifying an Ultrasonic Procedure as an alternate to Radiography

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After a minimum of 10 years in the irradiated fuel bay at Ontario Power Generation (OPG), the used fuel bundles are transferred to DSCs

The containers are large: 2.12 m x 2.42 m, height 3.56 m, weight (loaded) 70 Mg.

Following loading with used fuel, the lid is lowered onto the container and welded closed.
1.25” weld

Lid to Base Closure Weld

Lid Shell (Reinforcing Ring)

Lid Bottom Plate

Base Outer Liner (Reinforcing Ring)

Base Flange

All dimensions are in inches.

* Reference Dimension
As the DSC is constructed to ASME Section III, the closure weld is subject to NDE (Radiography).

Radiography has some drawbacks...

- slow – about 12 hours per DSC
- x-ray radiation hazard
- at one facility, production is interrupted during radiography
- chemical waste

The nuclear regulator (CNSC), needed assurance that the quality of the proposed Phased Array Ultrasonic (PAUT) inspection would be at least maintained.
The CIQB is accepted by the CNSC as the appropriate body to independently qualify inspection procedures and, if required, personnel.

The CIQB is designed to operate according to the protocols of the European Network for Inspection and Qualification (ENIQ)

- Inspection Specification
- Inspection Procedure
- Technical Justification (Incl. Inspector training scheme)
- Independent review (to confirm procedure meets the specification)
CIQB asked Nuclear Waste Management Division to convert existing information into a formal Inspection Specification

- Engineering analysis defined “critical” and “target” flaw sizes
- Defined performance expectation against test blocks with plausible embedded flaws – all parties have a clear understanding of expectations.
CIQB assembled a small team of experts to conduct the independent review.

The expertise vested in the team was varied but complimentary

- UT, especially PAUT, radiography, training, procedure writing, inspection qualification, nuclear applications.

- The diversity of the team was of significant value.
OPG Inspection Maintenance & Commercial Services (IM&CS) designed the automated inspection system, assembled all relevant documentation, produced the Inspection Procedure and Technical Justification (TJ)

Provided all documentation to the CIQB

Some of the documents were in an early draft form
CIQB/Review Team Actions

- CIQB opened a Qualification Dossier (electronic) to contain all documents and records.
- Documents were passed to the Review Team by the CIQB.
  - Early draft versions caused problems as reviewers’ efforts became entangled in trivia rather than substantial technical issues.
  - Subsequent docs. Were in a much refined state which facilitated in-depth review.
The review team worked remotely, shared check lists; held “virtual” meetings.

Each Team member reviewed the documents individually – the Team leader consolidated all comments for dispositioning by the ISP.

OPG IM&CS responded to all items and offered dispositions to the reviewers, via the CIQB.
A second round of comments/questions followed, with a repeat of the dispositioning process – resulting in consensus between the Review Team and ISP

- Non-adversarial process

Qualification, being an interactive process, often required additional information. Proactive dialogue between the Review Team, the CIQB and the ISP minimized delays

The Review Team recommended to the CIQB that the procedures be declared qualified.
ISP/NWMD/Regulator Actions

- OPG Nuclear Waste Management Division (NWMD)/IM&CS invited the regulator to witness the inspection system in action on the representative test pieces with embedded flaws.
- NWMD provided the CNSC with relevant documentation, including CIQB’s qualification report.
- The CNSC accepted the automated PAUT system as providing adequate inspection of the DSC Lid Closure Weld.
All parties agreed that the resulting Inspection Procedures were improved through the process.
The automated PAUT system was placed into service as an alternate to radiography.
The radiation hazard is eliminated.
The inspection time has been reduced significantly.
 Interruption of production has been eliminated.
Many individuals contributed to the success of this undertaking, including:

- Jim Sato, OPG NWMD
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- Ki Sang Jang, CIQB, COG
- Doug Whitely, CINDE
- Larry Etherington, Eclipse Scientific