FRAMATOME TECHNOLOGIES

NEWS RELEASE

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FTI SUCCESSFULLY APPLIES ELECTROSLEEVE™ AT CALLAWAY

Framatome Technologies has successfully completed the first U.S. application of an innovative nuclear power steam generator tube sleeving process, repairing degraded and damaged tubes, allowing those tubes to remain in service.

The sleeving process, called Electrosleeve™, was applied in October to steam generator tubing at AmerenUE's Callaway Nuclear Plant. The Electrosleeve™ technology was originally developed by Ontario Power Technologies, a business unit of Ontario Power Generation, Inc.

The process eliminates the risks associated with other steam generator tube repair technologies by neither inducing nor leaving stresses in the parent tube, the sleeve itself or the tube/sleeve combination. Electrosleeved tubes have been in operation in Canada at OPG's Pickering Unit 5 since 1994.

At Callaway, FTI successfully installed Electrosleeve in 57 steam generator tubes. In addition to installing the sleeves, FTI provided licensing support to AmerenUE during the NRC licensing process.

"The Electrosleeve process worked as intended, and tubes that otherwise would have been plugged were left in service," said FTI President Lyle Bohn. "We

More . . .

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Electrosleeve Aproved

The Nuclear Regulatory Commission has issued a license for AmerenUE to use sleeving process in the Steam Generator tubing at its Callaway nuclear plant. The sleeving process, called ElectrosleeveTM, will be applied by the U.S. licensee, **Framatome Technologies, Inc. (FTI)** at the Callaway plant's outage this fall. The ElectrosleeveTM technology was originally developed by Ontario Power Technologies, a business unit of Ontario Power Generation, Inc. **Reader Service No. 203.**

Nuclear Plant Journal, July-August 1999

FTI electrosleeving SG tubes at Callaway

Framatome Technologies Inc. (FTI) is this fall electrosleeving steam generator tubing at Callaway NPP in the US.

The electrosleeve process – originally developed by Ontario Power Technologies – is intended as a complete pressure boundary repair for SG tubing.

The resulting sleeve provides high resistance to fatigue, wear and corrosion.

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Nucleonics Week—11/11/99

CALLAWAY FIRST U.S. UNIT TO USE ELECTROSLEEVE TUBE REPAIRS

AmerenUE's Callaway ended a 35-day refueling outage Nov. 5, coming back on the grid as the first U.S. nuclear plant to use Electrosleeve technology for steam generator tube repairs.

The technology, developed by a unit of Ontario Power Generation (OPG), was installed by Framatome Technologies Inc. (FTI). The sleeving process is heralded by FTI not only as a means to avoid heat stress often associated with welding, but as a more permanent method of tube repair. FTI said it installed Electrosleeves in 57 steam generator tubes at Callaway.

AmerenUE does not disclose the cost of Callaway refueling outages, except for figures contained in end-of-year reports filed with the Securities & Exchange Commission (SEC). A company spokeswoman said a typical Callaway refueling costs about $30-million, including replacement fuel.

"The Electrosleeve process worked as intended, and tubes that otherwise would have been plugged were left in service," said FTI President Lyle Bohn. "We now will continue to build on this first application, and continue to improve the process," he said. Callaway officials said the Electrosleeve repairs were made in five to seven days, comparable to other repair methods.

FTI also provided licensing support to AmerenUE, helping convince the NRC to approve a two-cycle trial run at Callaway (NW, 27 May, 2). The NRC had feared that long cracks repaired with the new process might weaken at severe accident temperatures. But the concern was not sufficient to convince the agency to impose a "flaw length limit" on tube cracks repaired via Electrosleeve.

Callaway officials hope Electrosleeve will provide "a life of the plant repair"--meaning around 25 years. By contrast, the best experience Callaway has had with prior repairs was 10 years, said Tim Herrmann, supervisor of safety analysis and steam generators at Callaway.

The process is intended as a "cost-effective alternative to steam generator replacement," according to FTI. The process uses a series of low-temperature electro-chemical operations to result in a sleeve that has an integrated metallurgical bond to the steam generator tube, the company said.

Electrosleeved tubes have been in operation in Canada at OPG's Pickering-5 since 1995, FTI said.

Various other jobs were done during this outage at the Westinghouse PWR. Two of the four reactor coolant pumps were replaced. Workers also overhauled one of Callaway's three low-pressure turbines and conducted a pressurized leak test of the containment building--a test that must be done every 10 years. AmerenUE Vice President/Chief Nuclear Officer Garry Randolph praised Callway employees, saying the 35-day outage was better than the U.S.

Framatome extends its reach

Until 2004, engineering and maintenance services for Eskom's Koeberg plant (PWR, 2x965MWe) in South Africa are to be supplied by French nuclear contractor Framatome. The contract was signed on 1 June this year, and it will cover eight scheduled outages, the first of which began in mid September.

The contract is described by Framatome as fulfilling classical shutdown routines. It includes:

- Co-ordination of scheduled outage work.
- Mechanical maintenance of valves and pumps, performed by Framatome teams headquartered in Lyons.
- Reactor coolant pump maintenance, performed by subsidiary Jeumont Industrie.
- Supply of spare parts, which will be sourced from France.
- Modification engineering analyses.
- Engineering support.
- Fuel loading and unloading.
- In-service inspections, including steam generators.
- Non-nuclear servicing work.

The contract is said to be worth some $24 million over the five year period, and two local South African companies will be employed for part of the work. They are Rotek, a subsidiary of Eskom, which will provide valve maintenance services, and JEV, which will provide modification engineering analyses. Following training by Framatome, local companies will also be used in some aspects of servicing.

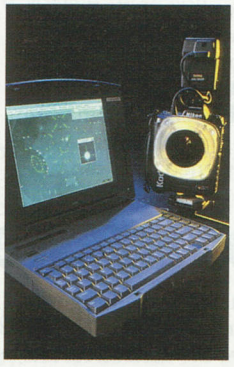
The Koeberg plant was designed and fabricated by Framatome and in fact was one of the first plants it exported as a turnkey project. The two units were started up in 1984 and 1985, respectively. Framatome says the new contract is intended to strengthen the co-operation which has been in place between Eskom and Framatome for many years to make it "more like a partnership".

US PARTNERSHIPS

Framatome's South African contract illustrates the company's intention to bring together its maintenance technologies to offer customers a services "package". The same intention is at work in the company's US arm, Framatome Technologies Inc.

Recently, for example, FTI has employed its Innovative Measurements Solutions (IMS) group to prepare for complex maintenance tasks. The IMS group evolved as part of FTI to support steam generator replacement projects, which often require very tight fit-ups for narrow groove welding. The group uses a variety of techniques, including photogrammetry, theodolites and laser trackers to obtain precise measurement data. Having such detailed data available provides a reliable basis for maintenance projects, ensuring they are completed as fast as possible.

IMS was used recently at TVA's Sequoyah plant, where it was necessary to replace a



Right: a photogrammetry digital camera.

containment spray heat exchanger. Fit-up tolerances of ±0.0625 in were required for the new heat exchanger, and the replacement was allotted a 10-day replacement window. The IMS group collected measurements of the old heat exchanger during operation, and produced a schematic accurate to ±0.005 in that could be used to fabricate the new unit. Once the replacement unit was completed the IMS team performed an inspection and identified two out-of-spec conditions, which were corrected. In making the schematic the IMS team also found a removal interference problem. According to FTI, this extensive checking process avoided unplanned modifications estimated at $75 000-125 000.

Photogrammetry station in use.

At Virginia Power's Surry plant the IMS group used photogrammetry to help in the replacement of residual heat removal piping. Photogrammetric measurements allowed the relative spatial position of the in-containment piping to be duplicated in the engineering shop, so that some sections could be pre-welded. Surry was able to move around 60% of the project machining and welding activities out of containment.

FTI has extended Framatome's traditional activity as a PWR specialist and this year, for example, it has been providing outage services at the Hope Creek BWR, owned by New Jersey based Public Service Electricity and Gas (PSE&G). Extensive balance of plant work included replacing emergency core cooling system suction strainers. The new strainers – which have a larger surface area, to reduce the potential for clogging during a design basis accident – had to be lowered into the torus and assembled by divers. The divers used new drilling techniques that enabled the required time to be reduced from an hour to 10 minutes per hole. The team had participated in a number of similar strainer replacements, and pre planning, including dry fit-up of the assemblies in advance of the outage, was maximised to reduce assembly problems.

FRAMATOME–SIEMENS LINK

FTI has recently signed a memorandum of understanding with Siemens Power Corp, US arm of the Germany-based power company, to bring together their businesses in chemical cleaning of steam generators.

The memorandum is expected to lead to an agreement on Siemens' patented high temperature chemical cleaning technology. Siemens will provide the process, expertise and equipment, while FTI will manage the application, providing personnel, equipment and waste processing services.

The agreement is presently restricted to the US but it is by no means the first time that Framatome and Siemens have worked together. Among other alliances, the two companies jointly own Nuclear Power International, which was set up as a joint venture company to design and market a new PWR, and market current products in third countries. The new reactor, known as the EPR, is still under development and is currently at a detailed design phase.

Heat exchanger replacement at Sequoyah.

There is continued speculation that the next in the current spate of mergers and acquisitions in the power industry may bring Siemens and Framatome together permanently. The possibility was raised once more recently when Alcatel of France said it planned to sell its stake in Framatome. French industry minister Pierre commented then that Siemens and Framatome were "natural partners", but so far Siemens has not taken the bait

Top and left, feedwater heater exchange at Salem.

REVUE GÉNÉRALE NUCLÉAIRE | novembre 1999

FRAMATOME À POINT BEACH ET GINNA

L'inspection et le remplacement des vis d'internes des cuves de réacteurs aux États-Unis

par Kirk NEAL, *Framatome Technologies Inc. (FTI)*
et Jean-Claude CHAUMONT, *Framatome*

Framatome Technologies Inc. (FTI), filiale américaine de Framatome, a réalisé l'inspection des vis de cloisonnement des internes des cuves de Point Beach 2 et Ginna aux États-Unis, et le remplacement d'un certain nombre d'entre elles. Les procédés et outillages vendus par FTI étant directement issus de ceux mis en œuvre quelques années plus tôt par la division Services composants primaires de Framatome, une partie des outillages utilisés par FTI ont donc été développés et fabriqués par le Centre de développement des outillages de Framatome, le Cedem à Chalon-sur-Saône. Quelques membres de la division Services composants primaires de Framatome sont intervenus en assistance technique à FTI pendant les opérations.

Le temps est aujourd'hui à l'expertise des vis extraites et au retour d'expérience, avant de reprendre les autres interventions au programme de FTI.

Cloisonnements et vis d'internes

Les plaques de cloisonnement des équipements internes inférieurs se trouvent placées à l'intérieur de l'enveloppe de cœur du réacteur. Elles sont constituées de plaques planes (25 mm d'épaisseur) qui épousent exactement la forme du cœur de manière à diriger le flux du réfrigérant primaire au travers des assemblages combustibles.

Un réacteur de 900 MWe conçu par Framatome comporte 44 plaques de cloisonnement fixées sur huit renforts horizontaux par un ensemble d'environ 1 000 vis ; les renforts sont eux-mêmes fixés à l'enveloppe de cœur.

En raison de leur proximité du cœur, les plaques de cloisonnement et les vis, faites d'acier inoxydable austénitique, sont soumises à un flux neutronique élevé.

Le problème de fissuration des vis de cloisonnement d'internes est apparu à la fin des années 1980 dans des réacteurs européens de première génération. Il se trouve aujourd'hui aggravé dans de nombreux cas par le vieillissement des centrales : sur la vingtaine de réacteurs, pour lesquels des contrôles ont été effectués, neuf ont montré une dégradation des vis.

Bugey d'abord...

À la fin des années 1980, des fissures étaient découvertes sur les vis de cloisonnement du réacteur de Bugey 2. L'expertise des vis extraites avait révélé une corrosion sous tension, « assistée » par irradiation. Les plaques elles-mêmes ne sont pas l'objet de contraintes de traction en fonctionnement normal et ne sont donc pas sujettes à l'apparition de cette corrosion. Par contre, elles cumulent la même irradiation que les vis ; elles deviennent fragiles par modification de leurs propriétés mécaniques. Si un trop grand nombre de vis étaient fissurées, un accident grave, tel que la perte du réfrigérant primaire, pourrait conduire à la rupture des plaques par déformation due à la différence de pression entre le cœur et l'extérieur.

Tihange ensuite

La première opération d'envergure concernant la visserie en acier inoxydable sur une centrale de type Westinghouse a été réalisée sur la tranche 1 de Tihange (Belgique).

(On rappelle qu'en 1986, un premier problème affectant les plaques de cloisonnement de Tihange 1 - le flux de réfrigérant pénétrait dans le cœur entre deux plaques et endommageait les assemblages combustibles - avait été réglé par une « conversion up-flow », destinée à supprimer la différence de pression entre les deux faces du cloisonnement, réalisée par Framatome.)

En 1991, Visionic réalisait l'inspection complète (960 vis) par ultrasons, laquelle révélait quelques vis fissurées. En 1992, Framatome remplaçait six vis, mais devait se retirer, ses outillages ayant été endommagés par la très forte irradiation des cloisonnements. Enfin, en 1995, Electrabel demandait à Framatome d'inspecter la totalité des 960 vis : 91 étaient remplacées.

Des exploitants américains lancent un programme d'inspection des vis

En 1997, suite aux retours d'expérience français et belge, des exploitants de réacteurs américains construits par Westinghouse lancent un programme d'actions préventives : analyse de matériaux, inspection des vis de cloisonnement de leurs réacteurs et remplacement des vis défectueuses. Ce programme est conduit en liaison avec l'Epri (Electric Power Research Institute), sous le contrôle de la NRC, l'autorité de sûreté américaine.