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REACTOR PRESSURE VESSEL LIFE CYCLE MANAGEMENT AT THE CALVERT CLIFFS NUCLEAR POWER PLANT

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ABSTRACT

Life Cycle Management (LCM) seeks to manage the aging process of important systems, structures, and components during licensed operation. The goal of Baltimore Gas and Electric Company's (BG&E) Life Cycle Management Program is to assure attainment of 40 years of operation and to preserve the option of an additional 20 years of operation for the Calvert Cliffs Nuclear Power Plant (CCNPP). Since the reactor pressure vessel (RPV) has been identified as one of the most critical components with regard to long-term operation of a nuclear power plant, BG&E initiated actions to manage life limiting or aging issues for the CCNPP RPVs. To achieve long-term operation, technical RPV issues must be effectively managed. This paper describes methods BG&E uses for managing RPV age-related degradation.

INTRODUCTION and BACKGROUND

Since the RPV has been identified as one of the most critical nuclear power plant components with regard to long-term operation, BG&E evaluated how RPV issues were resolved at the CCNPP. This review indicated RPV issues were handled through multiple processes and procedures under different organizations. Consequently, ownership and continuity could be sacrificed in the RPV issue resolution process. In addition, affected organizations were not always recognized or involved until late in the process. Since the resolution of RPV issues often requires the coordinated effort of many line organizations, BG&E established the Reactor Vessel Engineering Work Group (RVEWG) to provide a multidisciplinary forum for resolving RPV concerns.

THE REACTOR VESSEL ENGINEERING WORK GROUP (RVEWG)

The RVEWG is comprised of representatives from the line organizations listed below in Table 1 and provides communication and cooperation between affected organizations by involving them in decision making regarding RPV issues. This multidisciplinary forum also provides the vehicle to define, modify, and implement the necessary programs for managing age-related degradation that affect the CCNPP RPVs.

Table 1. Line Organizations Represented On The RVEWG

Plant Engineering	Design Engineering
Strategic Engineering	Nuclear Regulatory Matters
Operations Support	Chemistry
Technical Services, Nuclear	Materials Engineering and Analysis
Project Management	Outage Management
Electrical & Controls Maintenance	Mechanical Maintenance

The RVEWG accomplishes this by:

Defining problems

Defining action items regarding RPV aging issues

Evaluating existing RPV programs

Developing program modifications or new programs for the RPV

Identifying and maintaining program records that are necessary to support the program

Identifying operating and maintenance strategies to ensure maximum RPV availability.

The RVEWG and the issue resolution process is endorsed and supported by the management of each line organization, which provides the long-term corporate commitment for managing RPV issues.

When addressing an issue, RVEWG representatives have program oversight responsibilities. They agree on the technically qualified individuals that will comprise the program "subgroup", who are often, but not necessarily, RVEWG members. The program subgroup develops a charter and action plan. Once approved by the RVEWG, the action plan recommendations are submitted for management approval. Once management concurrence is obtained, the action plan is assigned to the cognizant line organizations for execution. The RVEWG and the subgroup continue to provide oversight and support.

For example, PTS is handled under RVEWG oversight by the PTS subgroup. The subgroup members include nuclear engineering analysis and core physics, licensing, materials engineering, and life cycle management personnel. These individuals' corresponding line organizations have PTS responsibilities such as: drafting the PTS submittal, calculations for embrittlement predictions, core characteristics and flux reduction, and material chemistry. This subgroup developed an action plan (described below), obtained management concurrence, and is now executing the plan.

Thus far, RVEWG program subgroups have evaluated existing programs (e.g., the Reactor Vessel Surveillance Program), have developed new programs (e.g., the Pressurized Thermal Shock and Records Management Programs), and are developing new programs (e.g., the Integrated Surveillance and Alloy 600 Programs).

PRESSURIZED THERMAL SHOCK PROGRAM

The Pressurized Thermal Shock Program was established in response to the 1991 revision of 10 CFR 50.61, "Fracture Toughness Requirements for Pressurized Thermal Shock." As a result of the changes in the prediction methods, neutron embrittlement is the life limiting aging mechanism for the CCNPP Unit 1 RPV. Without remedial actions, the PTS screening criterion will be reached in approximately 2005. There are several methods available to address PTS. These include flux reduction through core configuration changes and/or shielding, use of plant specific data in PTS calculations, analysis in accordance with Regulatory Guide 1.154, and RPV annealing. Therefore, the PTS subgroup was established to determine the preferred method, or combination and timing of methods, for addressing PTS. The charter of the subgroup was to develop the strategy to allow CCNPP RPVs to operate for 60 years. This subgroup considered all known methods for resolving PTS concerns and accounted for technical, economic, and regulatory factors in the decision analysis techniques employed to recommend the optimum strategy.

REACTOR VESSEL SURVEILLANCE PROGRAM

The original surveillance program meets all applicable NRC regulations and adequately monitors reactor vessel mechanical property changes. However, it lacks some elements needed to better characterize radiation embrittlement through the end of the current license and a license renewal period, should it be pursued. Therefore, BG&E developed the Comprehensive Reactor Vessel Surveillance Program (CRVSP). This program includes several additional aspects, such as supplemental surveillance capsules, an integrated surveillance program, supplemental dosimetry, and archive material. The CRVSP goal is to ensure all data necessary to evaluate and mitigate the effects of radiation embrittlement are available.

INTEGRATED SURVEILLANCE PROGRAM

The Integrated Surveillance Program is being developed under the CRVSP to better characterize the actual radiation embrittlement susceptibility of the Unit 1 limiting weld. Since this material is not one of the surveillance program materials, BG&E will use data from another utility's surveillance program which includes the CCNPP Unit 1 limiting weld. This program will be in accordance with 10 CFR 50 Appendix H requirements and the data is expected to show less susceptibility to embrittlement than 10 CFR 50.61 predicts.

ALLOY 600 PROGRAM

The Alloy 600 Program is being developed to address the concerns resulting from the French and Swedish experience with cracking of reactor vessel head penetrations. BG&E is actively participating in industry Alloy 600 activities. The Alloy 600 program subgroup, chaired by our industry representative, is developing plans and mitigating strategies.

REACTOR PRESSURE VESSEL LIFE CYCLE MANAGEMENT PROGRAM PLAN

BG&E is evaluating the effectiveness of the above, and other, programs that address age-related degradation through the CCNPP Reactor Vessel Life Cycle Management Program Plan. BG&E initiated this program plan to support operation during the current and renewed licenses by providing:

data and information relevant to CCNPP RPVs with regard to age-related degradation and,

programmatic actions that will mitigate age-related degradation.

This program plan will identify all plausible age-related degradation mechanisms for CCNPP RPVs and will provide detailed technical evaluations of existing programs that manage aging. Programs that are not adequate to mitigate age-related degradation will be modified and new programs will be developed where no program exists. These will be supported by the RVEWG.

RECORDS MANAGEMENT PROGRAM

This program identifies the records required to trend RPV age-related degradation in support of the current 40 year license period, and during a 20-year license renewal period, should it be pursued. These records directly support RVEWG activities and the Reactor Vessel Life Cycle Management Program Plan. Presently, data bases are being queried, and the pertinent operating logs, maintenance logs, drawings, and reports are being reviewed to ensure information availability. A comprehensive set of RPV records is being assembled, and will be available site-wide on a local area network (LAN).

PROGRAM BENEFITS

Several improvements resulted from establishing the RVEWG and the RPV LCM Program Plan:

Corporate commitment to solving long-term RPV age-related degradation issues has been formalized.

Working-level (Plant Engineering, Maintenance and Operations) personnel are always involved in decision making at the inception of each issue. This provides a perspective on the practicality of potential solutions as early as possible.

The team approach increases the communication and definition of issues, the completeness and timeliness of technical evaluations and the definition and implementation of solutions. As a result, RPV issues are addressed in a timely manner and are less likely to become crises.

A forum and process are provided for integrating industry (e.g. ASME, NUMARC, ASTM, and EPRI) activities.

RPV issues are addressed with regard to life cycle management and license renewal. Programs that address age-related degradation are being evaluated, modified and developed as appropriate.