ENCLOSURE 5

APP-GW-GLY-047 Revision 0

Closed Meeting – Westinghouse AP1000 Reactor Coolant Pump Technical Update – October 29, 2014
(Non-Proprietary)

This is the Non-Proprietary version of the document.

AP1000® Reactor Coolant Pump Technical Update

October 29, 2014

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Objectives

- Provide the NRC Staff with:
  - The latest information on the ***AP1000*** Reactor Coolant Pump (RCP) technical challenges and status of the resolution plan
  - Insight into potential licensing changes resulting from RCP resolution effort

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Agenda

- Background
- Status of Resolution
- Technical Changes and Challenges
- Potential Licensing Impacts
- Schedule for NRC Interaction

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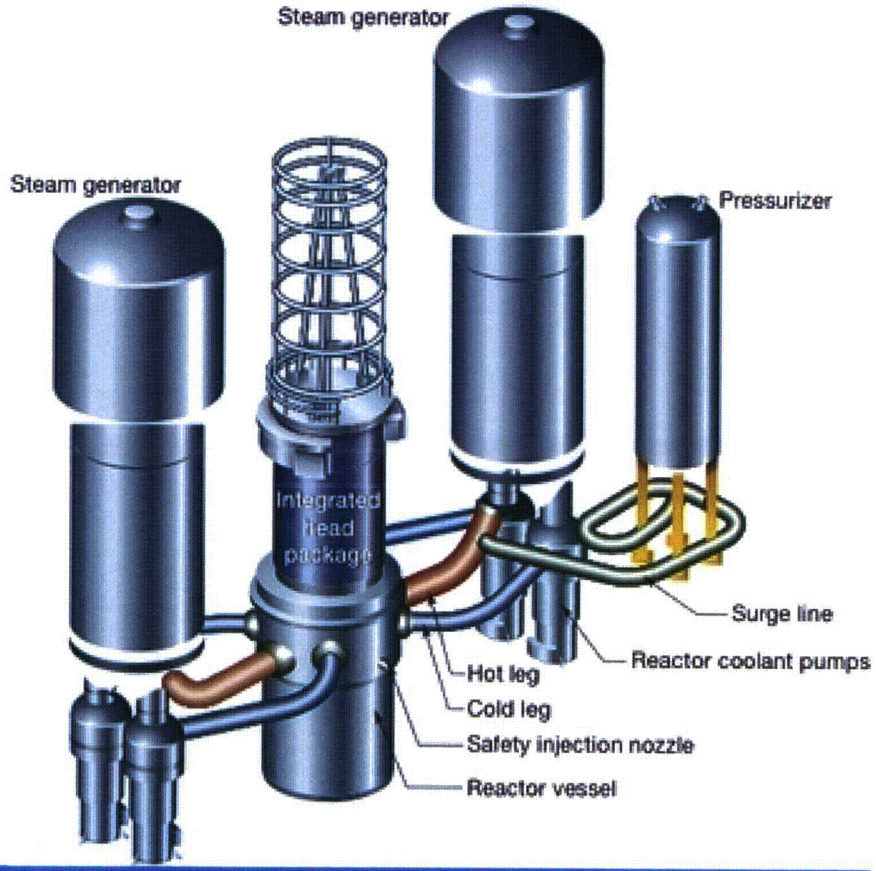
Background

Reactor Coolant Pump Description

- Reactor Coolant Pumps (RCP) provide the motive force for circulation of coolant through the fuel in the Reactor Vessel (RV) to remove heat and transport the heat to the Steam Generator (SG)
- There are 4 RCPs for each ***AP1000*** unit
- Two RCPs are coupled with each Steam Generator



AP1000 **plant reactor coolant pump design is proven technology**

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RCP Safety-Related Functions

- RCPs are components of the Reactor Coolant System (RCS). The RCS safety-related functions primarily provide for:
  - The integrity of the reactor coolant pressure boundary,
  - The capability to shut down the reactor and maintain it in a safe condition,
  - The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures.
- The ***AP1000*** RCPs have two safety-related functions:
  - The RCPs serve as a pressure boundary for containing the reactor coolant
  - The RCPs maintain reactor flow during coastdown

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Selection of Canned Motor Pump for ***AP1000***

- Gen 2 RCPs require continuous seal water injection powered by AC power – susceptible to seal LOCA
  - Sealless RCPs eliminate potential for seal LOCA and support ***AP1000*** simplification goals
- Canned motor pump was selected for ***AP1000*** based on:
  - Chosen for AP600 design
  - Westinghouse (now Curtiss-Wright) EMD large experience base with canned motor pumps in Naval Nuclear program
  - Meets ALWR Utility Requirements Document for Passive Plants
  - Reduced maintenance requirements
- EMD has delivered 1500+ canned motor pumps

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First-of-a-Kind Challenges with ***AP1000*** RCP

- ***AP1000*** RCP design requirements differ from historic canned motor pump applications:
  - Increased head-flow capacity
    - Larger power RCP, physical dimensions and thrust bearing diameter
  - Flywheel incorporated to improve flow coastdown
    - Lower flywheel incorporated into double-acting thrust bearing
  - RCPs mounted motor-down below Steam Generator

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Problem Statement

- Engineering tests and design reviews were completed in Q1 2012.
- One of these tests included the Loss of Cooling Water (LOCW) test
  - The RCP is designed to accommodate LOCW transients during plant operation.
- To confirm a minor design change (unrelated to RCP bearing components), an additional RCP was tested in October 2013 and failed the LOCW test.
- Subsequent LOCW tests were performed, but yielded inconsistent results.

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Status of Resolution

Technical Changes and Challenges

Plant Design Changes

Summary of Plant/Operational Design Changes

- To reduce challenges on the RCP additional Protection & Safety Monitoring System (PMS) logic will be proposed to protect the RCP from experiencing a severe LOCW transient and provide asset protection for the RCP
  - NRC approval required for this change
- In concert with the physical design changes to the RCP, operational changes are being implemented to ensure bearing film thickness will be maintained during various operating conditions
  - No licensing impacts for these changes
  - These RCP operational changes are:
    - Increasing the minimum RCP speed
    - Changing the acceleration strategy for the RCP

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Existing RCP Trip Logic

- Trip on high bearing water temperature
  - Four Resistance Temperature Detectors (RTDs) per pump, connected to the Protection & Safety Monitoring System (PMS, Safety-related I&C)
  - Protects against absolute high temperature

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Bearing Water Temperature Logic Changes

- Logic will be added to PMS to provide asset protection against a rapid increase in bearing water temperature

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- Both rate-lag and lead-lag compensation already used:
  - For over 40 years in operating plant protection systems
  - In several applications in the ***AP1000*** PMS
- Both rate-lag and lead-lag are standard elements for the PMS (No custom software development required)

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Increase in Minimum RCP Speed

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The value for RCP minimum speed is not in the licensing basis.

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Acceleration Strategy

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The acceleration rates for the RCP are not in the licensing basis.

Acceleration Strategy

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Potential Licensing Impacts

Regulatory Screening

- ***AP1000*** RCP design changes and related plant/system modifications have been evaluated against the Current Licensing Basis (CLB) for both the China and Domestic projects
- Based on the resolution path taken there is no impact to the safety analysis due to the RCP design changes
- The only change with licensing impacts is the proposed PMS logic changes for asset protection
- Preliminary mark-ups are provided on the following slides

Licensing impacts have been identified and are under evaluation.

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PMS Logic Changes – Preliminary List

- Assuming Rate-Lag:
  - Tier 1
    - Tables 2.5.2-2, 2.5.2-6
  - Tier 2
    - Sections 1.2.1.2.3, 5.4.1.3.4, 5.4.1.3.5, 7.2.1.1.3, 7.3.1.2.5
    - Tables 7.2-1 & 7.2-2, 7.3-1, 7.3-2, 14.3-2, 16.1
    - Figure 7.2-1
    - Technical Specifications (DCD Rev19): Tables 3.3.1-1 function 11.b and 3.3.2-1 function 11.b (and Bases)

Tier 1 Table 2.5.2-2 – Preliminary

2.5.2 Protection and Safety Monitoring System

Design Description

The protection and safety monitoring system (PMS) initiates reactor trip and actuation of engineered safety features in response to plant conditions monitored by process instrumentation and provides safety-related displays. The PMS has the equipment identified in Table 2.5.2-1. The PMS has four divisions of Reactor Trip and Engineered Safety Features Actuation, and two divisions of safety-related post-accident parameter displays. The functional arrangement of the PMS is depicted in Figure 2.5.2-1 and the component locations of the PMS are as shown in Table 2.5.2-9.

6. The PMS provides the following safety-related functions:

   a) The PMS initiates an automatic reactor trip, as identified in Table 2.5.2-2, when plant process signals reach specified limits.

If rate-lag is pursued, add "Reactor Coolant Pump High Bearing Water Temperature Rate Trip" to Tier 1 Table 2.5.2-2

Impacts may be less based on final design selection

Table 2.5.2-2
PMS Automatic Reactor Trips

Source Range High Neutron Flux Reactor Trip
Intermediate Range High Neutron Flux Reactor Trip
Power Range High Neutron Flux (Low Setpoint) Trip
Power Range High Neutron Flux (High Setpoint) Trip
Power Range High Positive Flux Rate Trip
Reactor Coolant Pump High Bearing Water Temperature Trip
Overtemperature Delta-T Trip
Overpower Delta-T Trip
Pressurizer Low Pressure Trip
Pressurizer High Pressure Trip
Pressurizer High Water Level Trip
Low Reactor Coolant Flow Trip
Low Reactor Coolant Pump Speed Trip
Low Steam Generator Water Level Trip
High-2 Steam Generator Water Level Trip
Automatic or Manual Safeguards Actuation Trip
Automatic or Manual Depressurization System Actuation Trip
Automatic or Manual Core Makeup Tank (CMT) Injection Trip
Passive Residual Heat Removal (PRHR) Actuation Reactor Trip

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Tier 2 Section 1.2.1 – Preliminary

1.2.1.2.3 Reactor Coolant Pump Design

- The reactor coolant pumps are designed such that they are not damaged due to a loss of all cooling water until a safety-related pump trip occurs on high bearing water temperature. This automatic protection is provided to protect the reactor coolant pumps from an extended loss of coolant water.

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Tier 2 Section 5.4.1 – Preliminary

5.4.1.3.4 Coastdown Capability

It is important to reactor protection that the reactor coolant continues to flow for a time after reactor trip and loss of electrical power. To provide this flow, each reactor coolant pump has a high-density flywheel and high-inertia rotor. The rotating inertia of the pump, motor, and flywheel is used during the coastdown period to continue the reactor coolant flow. The reactor coolant pump is designed for the safe shutdown earthquake. The coastdown capability of the pump is maintained even for the case of loss of offsite and onsite electrical power coincident with the safe shutdown earthquake. Core flow transients and figures are provided in subsections 15.3.1 and 15.3.2.

A loss of component cooling water has no impact on coastdown capability. The reactor coolant pump can operate without cooling water until a safety-related pump trip occurs on high bearing water temperature. This prevents damage that could potentially affect coastdown.

The reactor trip system maintains the pump operation within the assumptions used for loss of coolant flow analyses. This also provides that adequate core cooling is provided to permit an orderly reduction in power if flow from a reactor coolant pump is lost during operation.

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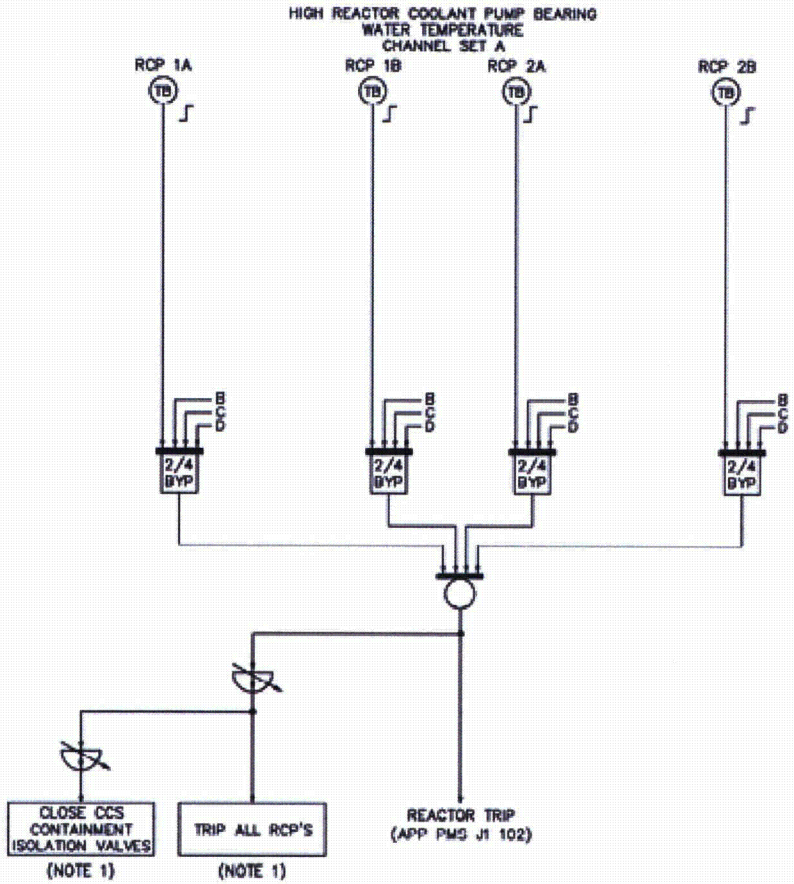
Tier 2 Figure 7.2-1 – Preliminary

- If lead-lag compensation is selected, existing bearing water temperature trip will be revised accordingly
- If rate-lag compensation is selected, logic for a new rate-lag based trip will be added



Current RCP Trip Logic shown in Figure 7.2-1 (Sheet 5) will be revised accordingly

ISG-11 Considerations

- ISG-11 clarifies the NRC position regarding changes to the ***AP1000*** licensing basis and whether a Combined License Applicant should report the change to the NRC to support the review of a Combined License Application.
- Only licensing impact is related to the PMS Logic Asset Protection changes.

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China Licensing

- A standard approach is being implemented for the ***AP1000*** design.
- Impacts to Domestic licensing basis are essentially the same as the China licensing basis.
- Regulatory process is different:
  - Domestic: 1-step "certified design" process (10 CFR Part 52)
    - No ITAACs
  - China: 2-step process (similar to 10 CFR Part 50)

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Schedule for NRC Interaction

Preliminary Timeline

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Conclusion

Conclusion

- Causes of loss of bearing film is known and design changes have been implemented in the RCP design
- Testing has been performed with the design and operational changes incorporated and demonstrated predicted results
- Design and operational changes made to the RCP have no impact to the supporting safety analysis
- Standard resolution approach for both Domestic and China ***AP1000*** plants
- Proposed PMS changes will be provided via LAR for NRC review and approval

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Questions?

DCP_NRC_003279
October 15, 2014

ENCLOSURE 6

14-APK-0100

"EMD Application for Withholding Proprietary Information from Disclosure" and Associated Affidavit dated October 9, 2014

EMD
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U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555
Letter No.: 14-APK-0100
October 9, 2014

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Transmittal of Proprietary and Non-Proprietary Information, AP1000 RCP "14-APK-097 - AP1000 RCP Bearing Damage Investigation Update" presentation.

The Application for Withholding is submitted by Curtiss-Wright Electro-Mechanical Corporation (EMD) pursuant to the provisions of Paragraph (b) (1) of Section 2.390 of the Commission's regulations. It contains commercial strategic information proprietary to EMD and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10 CFR Section 2.390, Affidavit 14-APK-0100 accompanies this Application for Withholding, setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectively requested that the subject information which is proprietary to EMD be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to this Application for Withholding or the accompanying affidavit should reference 14-APK-0100 and should be addressed to Ms. Annette Bohinski, Senior Contracts Manager, Curtiss-Wright Electro-Mechanical Corporation, 1000 Wright Way, Cheswick, Pennsylvania, 15024.

Very truly yours,

John Tessaro
Chief Engineer

EMD
Curtiss-Wright
M: 412-225-6300

(1) I am the Chief Engineer at the Curtiss-Wright Electro-Mechanical Corporation, and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of EMD.

(2) I am making this Affidavit in conformance with the provisions of 10CFR Section 2.390 of the Commission's regulations and in conjunction with the EMD "Application for Withholding" accompanying in this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by EMD in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b) (4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by EMD.

(ii) The information is of a type customarily held in confidence by EMD and not customarily disclosed to the public. EMD has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes EMD policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of EMD's competitors without license from EMD constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of EMD, its customers or suppliers.

(e) It reveals aspects of past, present, or future EMD or customer funded development plans and programs of potential commercial value to EMD.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the EMD system which include the following:

(a) The use of such information by EMD gives EMD a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect EMD.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes EMD's ability to sell products and services involving the use of the information.

(c) Use by our competitor would put EMD at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, anyone component may be the key to the entire puzzle, thereby depriving EMD of a competitive advantage.

(e) Unrestricted disclosures would jeopardize the position of prominence of EMD in the world market, and thereby give a market advantage to the competition of those countries.

(f) The EMD capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10CFR Section 2.390, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in AP1000 RCP"14-APK-097 - AP1000 RCP Bearing Damage Investigation Update" dated October 2, 2014 in support the AP1000 Reactor Coolant Pump Technical Update (ADAMS Accession Number: ML14231A388) held on October 29, 2014.

This information is part of that which will enable EMD to manufacture and deliver products to utilities based on proprietary system designs.

Further this information has substantial commercial value because it reveals the distinguishing aspects of a process or component, structure, tool, method, etc., and the prevention of its use by competitors of EMD, without license from EMD, give EMD a competitive economic advantage.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of EMD because it would enhance the ability of competitors to provide similar technology for Reactor Coolant Pumps for commercial power reactors without commensurate expenses.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive EMD effort and the expenditure of a considerable sum of money.

In order for competitors of EMD to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

This information, if used by a competitor, would reduce the competitor's expenditure of resources or improve the competitor's advantage in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

Further the deponent sayeth not.

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

SS

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared John Tessaro, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Curtiss-Wright Electro-Mechanical Corporation (EMD), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

John Tessaro
Chief Engineer

Curtiss-Wright Electro-Mechanical Corporation

Sworn to and subscribed
before me this 9 day
of October, 2014

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Susan M. Hillery, Notary Public
Harmar Twp., Allegheny County
My Commission Expires March 29, 2016
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

Susan M. Hillery
Notary Public