APPENDIX I, Page AI-1 KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Characteristics of the Cooling Water

What type of water is used in the cooling water system? (fresh water, brackish water, saltwater, etc.)	
What is the physical / chemical / biological composition of the water ?	
What is the normal temperature range of the water as it moves through the component to be coated?	
What maximum / minimum water temperatures are expected?	
How often, and for what duration, are maximum and minimum water temperatures be encountered?	
Is the water acidic or alkaline? What is the pH of the water?	
At what velocity is the cooling water moving through the component?	
Is it typical for large debris to be carried in the source water? If so, What type(s) of debris? What is the size range?	
Is it typical for small debris to be carried by the source water? If so, What type(s) of debris; What is the size range?	
What is the solids content of the water? What is the size range? What is the average size?	
Are the solids being carried in the cooling water expected to cause severe erosion or abrasion?	
At what velocity are the solids moving?	
Is biofouling a problem? If so, what species? What are its characteristics? Is it seasonal, etc.?	
Is the removal of small marine organisms a problem?	
Is algae build-up a problem within the system?	
Is ice build-up on the cooling tower shrouds a problem?	
Is Zebra Mussel (dreissena polymorpha) build-up within the system a problem?	

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Description of the substrate to be coated

Identify the substrate(s) to be coated? (concrete, carbon steel, cast iron, stainless, steel, etc.)	 _
Is the substrate new or existing?	
Is the substrate deteriorated? If so, describe.	
Is the substrate contaminated? If so, describe.	
What method(s) are used to clean the components on a routine basis?	
Has the substrate been previously coated?	
What coating material was previously used?	
What is the condition of the previously applied coating?	
What is the normal temperature range of surfaces to be coated?	
What maximum / minimum surface temperatures are expected?	
How often, and for what time duration, will maximum and minimum surface temperatures be encountered?	
Are there hydrostatic pressure conditions which may affect coating application or performance ? If so, describe.	
Are there any active leaks, cracks, etc. which will need to be repaired?	
Is there exposed aggregate or exposed reinforcing steel on concrete surfaces to be coated? If so, describe.	
Are there any existing pits or perforations in metallic surfaces to be welded, filled flush or coated ?	
Will cathodic protection be employed? If so, what type and at what voltage, if any?	

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Questions on Pumps

What upset conditions could take place?	
What is the likelihood of that happening?	
How often and for how long?	
What upset conditions have taken place in the past?	
How does the pump operate? Is it operating within its designed parameters?	
What parts of the pump move? At what speed?	
Which parts of the pump remain stationary?	
What happens during pump start-up?	
What happens at pump shut-down?	
What volume of water is pumped? At what velocity?	
Is there impact and/or abrasion present?	
Define the splash zone.	
When and why does it vary?	
Which areas experience the most wear?	
Why? What are the causes of the wear?	
Are there dead zones?	
What is the material(s) of construction?	

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Questions on Valves

How does the valve operate?	
What parts move? At what speed? In what direction? How often?	
Which parts remain stationary?	
What happens during equipment start-up? What happens at shut down?	
What volume of water passes through this equipment? At what velocity?	
Is there impact, erosion cavitation and/or corrosion present?	
Which areas experience the most wear?	
Why? What are the causes of the wear?	
Are there stagnant or dead zones?	
What is the material(s) of construction?	
What happens when this piece of equipment malfunctions?	
Is thermal expansion a concern?	
Is the equipment completely immersed while in operation?	
What is the likelihood of the line moving due to expansion and contraction, construction settlement, surges in the system, water-hammering or any other condition?	
Does the new coating manufacturer require complete removal of previous coating?	
Will heating or dehumidification be required for application of the new coating?	
If the previously applied coating failed, what was the mode of failure? What were the reasons for coating failure?	

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

<u>Condenser / Heat Exchanger - Data Sheet</u>

<u>APPLICATION</u>	<u>CONDENSER</u>	<u>HEAT EXCHANGER</u>	<u>WATERBOXES</u>
Once Through Multi-Pass			
Tubesheet Material			
Size (H x W)			
# of Tubesheets			
Waterbox Material			
Size (H x W x D)			
# of Waterboxes			
Tube Material			
# / tubesheet			
OD / BWG / length	· · · · · · · · · · · · · · · · · · ·		
# plugged			
type plug			
tubes flush			
tubes flared			
tubes protrude			
Existing Coatings	Tubesheet	Tubesheet	Waterbox / channel
inlet - outlet			
thickness			
years in service			· ·
condition			
coating material			
Existing CP			
impressed current / sacrificial			

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Accessibility	Yes/No
1. Is the area accessible for the coating operation?	
2. Is equipment required to perform the coating work accessible to the work area?	
3. Is the removal of interferences such as insulation, equipment, piping, etc., required?	
4. Does the area have enough accessibility to permit the surface preparation and/or coating application technique?	
5. Is scaffolding equipment required for the coating work? (Ensure proper safety for workers.)	
6. Is any special personnel breathing equipment needed to support work? (Refer to OSHA, radiation control or government requirements.)	
Design Requirements and Configuration of	
the Surface(s) to be Coated	
1. Is the surface to be coated :	
(a) Flat?	
(b) Smooth?	
(c) Contain weld seams?	
(d) Vertical	
(e) Horizontal	
(f) Contain welded attachments?	
(e) Is the weld surface smooth? (Check the weld spatter)	
 Service level of equipment or components? (Refer to ASTM D-3843, Practice for Quality Assurance for Protective Coatings Applied to Nuclear Facilities.) 	
3. Quality assurance requirements? (Refer to ASTM D 3843)	
4. Quality control and testing requirements?	
5. Reasons for coating?	
(a) Corrosion protection?	
(b) Decontaminability?	
(c) Aesthetics?	
(d) Cleanliness?	

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Material (Substrate) to be Coated

1. Carbon steel?	
2. Stainless Steel?	
3. Alloys?	
4. Plastic?	
5. Concrete?	
6. Other non-ferrous materials?	
7. Other?	
Is the coating material approved for the substrate?	
Historical coating information available?	
Is the coating material recommended by the coating manufacturer for the substrate and service?	
Previously Coated Substrate	
1. Investigate existing coating's historical performance.	
2. Investigate possible failure modes and cause.	·
3. Can existing coating materials still be certified as qualified coatings?	
4. Based on the above, could the present coating material continue to be used?	
5. Do present coatings contain hazardous waste material, i.e. lead, asbestos, coal tar, etc.?	
6. Based on the above, should a new coating material be selected to prevent future failures?	
7. Inadequate coating process :	
(a) Improper surface preparation?	
(b) Improper coating application?	
(c) Inadequate testing?	
(d) Inadequate training of application personnel?	<u> </u>
(e) Inadequate training of preparation personnel?	
(f) Inadequate training of inspection personnel?	
(g) Inadequate procedures?	

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Present Substrate Corrosion Condition

1. Is the substrate presently corroded?	
2. Extent of corrosion, % (ASTM D-610)	
3. Type of corrosion :	
(a) General?	
(b) Pitting?	
(c) Stress corrosion?	
(d) Intergranular?	
(e) Other	
4. Are repairs to the substrate required prior to coating?	
5. Can the substrate be repaired?	
6. Are there procedures for the repair?	
7. Are repair procedures available?	
	-

Plant Operational Conditions

- 1. Do any of the following operating conditions affect the coating work or ability to work?
 - (a) High radiation levels?
 - (b) Area security requirements?
 - (c) Area temperature restrictions?
 - (d) Material and substrate temperatures?
 - (e) Accessibility (including confined space entry)?
 - (f) Ventilation requirements?
 - (g) Fire control restrictions?
 - (h) Protection required for plant engineered safety feature atmospheric cleanup system HEPA filters and absorption units?

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Radiation Levels

1.	Is the substrate radioactively contaminated?	
2.	Is the substrate radioactive?	
3.	Are the general area radiation levels within acceptable limits? [Verify with Plant Health Physics (HP) Department.]	
4.	Is there airborne contamination? (Verify with Plant Health Physics Department.)	
5.	Will surface preparation generate airborne contamination?	
6.	Type of breathing apparatus and clothing required? (Verify with Plant Health Physics Department and OSHA requirements.)	
7.	Is decontamination practical?	
8.	Should decontaminability be considered in the future?	
9.	If decontamination is not practical, can the contamination be sealed to the substrate?	
10	Will special ventilation and filtration equipment be required?	
11	Are special procedures required for the ventilation equipment operation?	
12	Are special and additional arrangements required for contaminated material disposal?	
Ir	n-service Inspection Requirements	
1.	Does the substrate require inspection as a part of an in-service inspection program?	
2. (Can the substrate remain uncoated to facilitate inspection?	
T	ime Constraints	
1. (Can the coating work be completed at one time?	

- 2. Should the coating work be divided into phases?
- 3. If the work is to be completed in phases, is the material/equipment to remain onsite?
- 4. Has the remobilization of workers been negotiated?

KEY QUESTIONS FOR EVALUATION OF SERVICE CONDITIONS

Weather/Climatic Conditions

- Is the work area susceptible to adverse climatic conditions?
 Can the work area be protected from the adverse conditions?
- 3. Are there temperature and humidity requirements for the coating material?
- 4. Have provisions been made to control temperature and humidity?
- 5. Can work area cleanliness be maintained?
- 6. Equipment placement and protection evaluated?
- 7. Equipment operation evaluated?
- 8. Material storage requirements considered (i.e., heating and ventilation requirements)?
- 9. Personnel considerations?

Material/Waste Disposal

- 1. Disposal requirements for the coating material waste checked?
- 2. Disposal requirements for the surface preparation material checked?
- 3. Disposal of radioactively contaminated material arranged?

Ventilation Requirements

- 1. Humidity control required? (Refer to coating data sheets.)
- 2. Temperature control required? (Refer to coating data sheets.)
- 3. Particulate filtration required? (Refer to OSHA requirements.)
- 4. Confined entry precautions?
- 5. Explosive concentrations to be monitored?
- 6. Air changes per hour calculated and adequate?

Safety Requirements

1. Personnel safety requirements checked? (Refer to Health Physics, OSHA, Mine Safety and Health Administration (MSHA), NIOSH, EPA, NRC, company and plant requirements) **APPENDIX II - COATING SELECTION CHART**

APPENDIX II			COMI		IS OF C	:00LIN	3 WATE	ER SYST	EMS			
									MAIN ST AND HE	IEAM CONI AT EXCHAI	DENSERS NGERS	
GENERIC COATING TYPES	Intake Struct.	Coarse Screens	Fine Screens	Trash Troughs	Pumps and Valves	Piping	Cooling Towers	Cooling Tower Basin	Water Boxes	Tube Sheets	Tubes	Disch. Struct.
Coal Tar Epoxies	×	×		×	×	×	×	×	×	×		×
Two-component epoxy systems (including epoxy phenolics)	×	×	×	×	×	×	×	×	×	×	×	×
Inorganic Zinc Silicates	x	×						-	×			×
Solventless (or low solids) elastomeric polyurethanes including coal tar urethanes	×	×		×	×	×	×	×	×	×		×
Rubber Linings					×	×			×			
Foul-release coatings (incl. Zebra Mussel control)	×	×	×	×		×			×			
Ice Release Coatings							×					
Thermal Metal Spray	×	×	x	×	×	×	×	×	×			×
Vinyl Ester						×			x			
Wood Preservatives	×	×					×					

SUGGESTED TEST METHODS FOR EVALUATION OF AND COMPARISON OF SPECIFIC COATING PRODUCTS

APPENDIX III

Physical Properties	Suggested ASTM Test Method	Physical Properties	Suggested ASTM Test Method
Abrasion Resistance	D 1242	Tensile Adhesion	D 429
(by Taber Abrasor)	D 4060		D 1002 (Metal Substrates)
(by Falling Abrasive)	D 968	Pull Off Strength	D 4541
(by Air-Blast)	D 658	Thermal Expansion	D 696
Tensile Strength	D 412, D 638		
Elongation	D 412, D 638	Salt Spray	B 117
Hardness	D 2240	Cathodic Disbondment	68
Compressive Strength	D 695	Water Vapor Permeability	E 96, D 1653, F 1249
Flexural Strength	D 790	Chemical Resistance	D 3912, C 868
Impact Resistance	D 256		NACE TM-1-74
(by Falling Weight)	G 14	Dielectric Strength	D 2305
Tear Resistance	D 624		

IMPORTANT NOTES : Comparison of physical/chemical properties of specific coating systems can assist in determining the product best suited for a given application. Contact coating manufacturers for product technical data.

In some cases, product data may include results from different test methods, and the user should consider such test results accordingly. The user should review the test methods to determine whether such test(s) may be applicable for the component of interest. The list of properties / test methods shown may not be applicable for all components of the cooling water system.