



GEK 110367
Revised, February 2002
Last Reviewed, October 2003

GE Power Systems

Protection of Steam Turbine Components

During Shipment and Prior to Start-up

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes the matter should be referred to the GE Company.

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ATTENTION

To the customers of GE Industrial & Power Systems who have Steam Turbine-Generators in installation or storage.

The purpose of this document is to present in outline form typical means used to protect steam turbine components for shipment from the factory to the installation or storage site. Further, the document suggests how best to protect these components during the erection procedure and while awaiting actual operation after assembly. It also presents recommended preservation, protection and maintenance procedures to be followed during interim extended storage periods of two years or less.

This information is furnished without charge to serve as a guide in giving proper protection in a given situation. In no case should it be considered a complete instruction. Protection of this kind of equipment can be complex and subject to so many variables that each owner must consider his individual circumstances. *THEREFORE, IT MUST BE THE RESPONSIBILITY OF EACH OWNER TO DETERMINE HIS PLAN OF PROTECTION, AND THE CONTENTS OF THIS DOCUMENT OR ITS USE WILL NOT CREATE ANY LIABILITY WHATSOEVER ON THE PART OF GE COMPANY OR ITS EMPLOYEES, WHETHER IN WARRANTY, NEGLIGENCE, OR OTHERWISE.* Where GE furnishes protection services and materials, the rights of the parties, including the applicable warranty, shall be as provided in that contract under which the work is to be done.

It should be recognized that the preservation and packaging methods listed herein are current as of the date of this publication. However, since improved methods and materials are constantly being introduced, the protective means described herein should be considered representative rather than specific. The preservation, protection and maintenance procedures for extended storage represent GE's best judgment based on limited experience and knowledge.

GE service engineers will be pleased to help any customer set the frequency of monitoring deemed necessary, and lay out an appropriate surveillance plan. Questions and interpretations with respect to the contents of this publication should be referred to the local GE Company service representative.

I. INTRODUCTION

The information provided herein has been prepared for the guidance and use of the purchasers of steam turbines to assist them in protecting the equipment both during normal installation periods and during storage or non-operation periods.

In Part II, the various methods that are used for protection during shipment are outlined. They are generally designed to protect the equipment during shipment and normal installation involving storage for up to 6 months, provided the equipment is received, stored and maintained after arrival in accordance with the recommendations of this publication. Additional protection may be needed when storage periods longer than six months are expected. The level of protection provided for equipment is generally dependant upon the destination and the duration of shipment, installation, and storage. GE designations for two levels of protection are Level "A" (overseas shipment or storage for up to 24 months) and Level "B" (overland shipment or storage for up to six months). Arrangements can be made for Level "A" protection by GE Company through the normal contractual channels.

The protective coatings and packagings will deteriorate and lose their effectiveness over a given period of time with the rate of deterioration dependant upon the local environment and actual storage conditions. Degradation of equipment could then occur unless it is reprotected. Deterioration would be particularly likely on electrical equipment, machined surfaces, and piping. Therefore, if the equipment is expected to be stored, the purchaser should plan and carry out a regular inspection and upgrading of the protective coatings and packagings. This program should start at the time of arrival of the first part and continue throughout the entire storage period. Recommendations are given in Part II through IV and Exhibits A through F on the storage of steam turbine components.

Before storing any equipment, a thorough inspection for damage to the packaging and protective coatings should be performed. Any damage should be reported and repaired, or reprotected. *It is recommended that all boxes should be opened upon receipt to verify the integrity of the contents. It is also desirable, although not essential, that the parts be inventoried at this time. Following the inspection, the boxes should then be resealed to prevent pilferage. Plastic covers should be permanently removed from all shipping boxes immediately after receipt. These covers effectively prevent direct entry of water during shipment, but may cause moisture to accumulate in the boxes due to condensation effects. However, equipment that is wrapped directly in VCI treated plastic or VCI treated paper laminated with plastic should not be unwrapped until the items are ready for use. If unwrapping is necessary for inspection or inventory, the equipment must be cleaned and re-wrapped shortly afterward with the VCI treated packaging materials or protected by other means, to prevent corrosion. Ensure that any bare metal protected by VCI has not been exposed to contaminants (i.e. finger prints). Install VCI emitters and reseal the box cover with RTV or equivalent to ensure it is moisture proof.*

The protective package on the turbine rotor journals warrants special attention. Although great care is taken to ensure these journals are properly protected in shipment, minute cracks may develop in the journal packaging during shipment. In such cases moisture can rapidly cause journal pitting to occur. *It is, therefore, strongly recommended that journal protection be removed (TECTYL) if there are any signs of deterioration within three weeks after arrival, and that inspection of the journals, and deflector and packing fits be made and reported. The preservation must be restored upon completion of the inspection. (See Part II.)*

In general, the protective methods described in this publication are acceptable to commercial carriers for domestic shipment without special shipping precautions. However, when water-borne carriers are used, the equipment should be placed below deck or securely covered by waterproof material to protect against water spray. Immediate inspection and cleaning are required on arrival should any contamination occur. (See Part III.)

The local GE representative should be consulted on any questions concerning the recommendations furnished in this publication. Also contact the local GE representative if any indication of deterioration is detected during receipt or storage of the steam turbine components.

NOTE

The term “storage” as used throughout this document refers to the entire period between shipment and start-up of the turbine.

II. METHOD OF PRESERVATION AND SHIPPING OF STEAM TURBINE COMPONENTS

A summary of the protection applied to the major components at the factory in preparation for shipment is given below. Also included are comments on shipping, receiving and storage methods where necessary.

To protect machined surfaces of components from corrosion during shipment and storage, a corrosion inhibiting oil, wax or asphalt based coating, VCI (Vapor Corrosion Inhibitor) wrapping, or combination of these is applied. Typically, the machined surfaces of large items such as hoods, shells, casings, and rotors are preserved with wax or asphalt based coatings. Smaller, loose parts or assemblies are typically wrapped with VCI treated papers and plastic products. There may or may not be a light coat of corrosion inhibiting oil on the item prior to wrapping in VCI material. Typically, items that lend themselves to being easily wrapped or bagged, are done so with VCI treated materials for corrosion protection.

Where an HP/IP is shipped assembled for example, the interior machined surfaces are typically preserved with a corrosion inhibiting oil.

Prior to installation, wax based coatings must be removed to prevent possible contamination of the feedwater system or assemblies with close tolerances, moving parts, orifices etc. Where corrosion inhibiting oils are used, they are considered compatible in all areas and need not be removed. Removal of wax or asphalt based coatings can present a time-consuming and costly operation for its removal. The following should be considered when removing wax based coatings:

1. Removal can be accomplished by the use of aliphatic or aromatic solvents, steam cleaning, or high pressure water washing. Condensate grade water shall be used.
2. For steam cleaners, the minimum operating conditions should be 100 psi at 300-350°F.
3. Water wash equipment at 4 g.p.m. (100 psi) and 210°F has the same removal rate as the 100 psi steam cleaner.
4. Pre-soaking with a solvent prior to using steam cleaning or water wash equipment gives only minimal improvement.
5. Detergents give only minimal improvements and in some cases contain undesirable contaminants.
6. Following the use of steam cleaning or water wash equipment, exposed metal should be immediately coated with a 5 to 10% solution of triethanolamine, or equivalent to prevent flash rusting of exposed surfaces.

Wooden cases designed for export or overseas shipments, Level "A", using board construction are lined on the sides and ends with waterproof or VCI treated paper, and the tops are capped with waterproof paper or plastic. Where cases are constructed with exterior grade plywood, waterproof liners and caps are not required. Appropriate blocking and spreaders are used where necessary. For domestic or overland shipments, Level "B", items may be supported in wooden skids or placed in fiber boxes depending upon weight. For all items, waxed cloth or polyethylene-backed VCI paper is applied wherever wood contacts bare metal. Non-hydroscopic dunnage is also used when necessary.

A tabulation of the preservation materials referenced in this Part, and sources from which they may be purchased, is appended as Exhibit A. When cushion boards are removed from any support surfaces, it should be expected that a portion of the wax or asphalt based preservative coating will come off from these surfaces. The surfaces should then be inspected, cleaned where necessary, and represerved.

THE NUMBERED ITEMS LISTED IN THIS PART ARE LISTED IN THE SAME SEQUENCE IN PARTS II AND III.

1. Assembled turbine section

a) External unmachined surfaces	Alkyd primer
b) Internal machined surfaces	VCI Oil
Storage recommendation	The assembled unit may be shipped to site on either an wooden or steel shipping skid. Wooden shipping skids are not recommended for long term storage due to the possible deterioration of the wood. If a wooden skid is used, it must be evaluated for soundness and any issues be corrected immediately and prior to re-shipment. Fabricated steel stands should be provided for long term storage. Long term preservation recommendations are contained in Section V.

2. High-pressure and reheat outer shells

a) External unmachined surfaces	Alkyd primer
b) Internal unmachined surfaces	Alkyd primer (non-nuclear), VCI paper or powder (nuclear) with environmental bag.
c) All machined surfaces	Wax based coating (asphalt based coating on support areas)
Shipping method	Steam entrance, extraction openings and pipe flanges are protected with appropriate covers (wood or metal). Waxed or VCI paper is installed at all contact points between metal and wood. Shipped on cushion boards, blocked and braced.
Storage recommendation	Remove cushion boards due to possible water entrapment in joint bolt holes and between wood and machined surfaces. Block up above ground level to a sufficient height to allow inspection of the joint surface. Pipe stands may also be used. Support points on machined surfaces should be isolated from blocking by utilizing steel pads. Neoprene (non-hydrosopic material) should be used to isolate machined surfaces from steel pads. Fabricated stands using lifting trunions as alternate support points allow complete inspection of machined surfaces. Blind and blocked holes should be filled with grease to prevent water accumulation.

3. High-pressure and reheat inner shells

a) External unmachined surfaces	Alkyd primer
b) Internal unmachined surfaces	Alkyd primer (non-nuclear), VCI paper or powder (nuclear) with environmental bag.
c) All machined surfaces	Wax based coating (asphalt based coating on support areas)

Shipping method	Steam entrance and extraction openings are protected with appropriate covers (wood or metal). Waxed or VCI paper is installed at all contact points between metal and wood. Shipped on cushion boards, blocked and braced.
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Storage recommendation	Same as Item 2.
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4. Low-pressure exhaust hoods

a) External unmachined surfaces	Alkyd primer
b) Internal unmachined surfaces in steam-containing areas	Alkyd primer (non-nuclear), VCI paper or powder (nuclear) with environmental bag.
c) All machined surfaces	Wax based coating (asphalt based coating on support areas)
d) Internal unmachined surfaces in oil-containing areas	Aluminum phenolic coating

Shipping method	By rail - Shipped with cushion boards or steel blocks bolted to the machined surface on which the piece is supported. Waxed or VCI paper is installed at all contact points between metal and wood. By truck - Shipped with cushion wood shipping skids bolted to the machined surface on which the piece is supported. Waxed or VCI paper is installed at all contact points between metal and wood.
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Storage recommendation	Same as Item 2.
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5. Low-pressure inner casings

a) External unmachined surfaces	Alkyd primer
b) Internal unmachined surfaces in steam-containing areas	Alkyd primer (non-nuclear), VCI paper or powder (nuclear) with environmental bag.
c) All machined surfaces	Wax based coating (asphalt based coating on support areas)
Shipping method & storage	Same as LP hoods.

6. Miscellaneous fabricated parts

a) External unmachined surfaces	Alkyd primer
b) Internal unmachined surfaces in steam-containing areas	Alkyd primer (non-nuclear), VCI paper or powder (nuclear) with environmental bag.
c) All machined surfaces	Wax based coating (asphalt based coating on support areas)
d) Internal unmachined surfaces in oil-containing areas	Aluminum phenolic coating

7. Rotors

a)Excluding journals	Wax based coating or wrapped in VCI paper
b)Journals	Asphalt based coating or wrapped in VCI paper and/or VCI plastic and wrapped in Textolite secured by tape. Exposed butt joints taped to seal out water. CAUTION Use extreme care when removing or reapplying coverings and coatings on journals. Journals are precision ground and must not be marred.
Shipping method	Shipped on wooden or steel skid and secured and blocked to transportation vehicle.
Storage recommendation	The protective package on the turbine rotor journals, oil deflector and packing surfaces warrant special attention. Although great care is taken to ensure the journals are properly protected in shipment, minute cracks may develop in the journal packaging during shipment. In such cases moisture can rapidly cause journal pitting to occur. It is, therefore, strongly recommended that journal protection be removed (TECTYL) if there are any signs of deterioration within three weeks of arrival, and that inspection of the journals, deflector and packing fits be made and reported. The preservation must be restored upon completion of the inspection. Wooden shipping skids are not suitable for long term storage due to the possible deterioration of the wood. Fabricated steel stands are recommended for long term storage and maintenance. • If a wooden skid is being used the skid must be monitored for soundness and any issues corrected immediately. Adequate protective materials (non-hydroscopic Teflon or Textolite) shall be used to protect the rotor at support surfaces (inbetween journal surface and wood). Teflon should never be used on journal bearing surfaces . LP nuclear rotors should be statically supported on the inboard side of the coupling hubs, however, this support should only be used for static storage and is not acceptable for local transit or during bucket assembly. All other rotors may be supported on their shipping surfaces.

8. Foundation and base plates

a)All surfaces	Wax base coating or wrapped in VCI paper and/or VCI plastic.
Shipping method	Shipped strapped to cushion boards. Waxed paper or VCI paper is installed at all points of contact between metal and wood when preserved with wax based coating.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment. Block off ground 8" to 12". Isolate machined surfaces from block with grade C waxed paper or VCI paper.

9. Front Standard

a)External unmachined surface not exposed to EHC fluid	Alkyd primer
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NOTE

Alkyd primer is also applied to external unmachined surfaces of MHC units.

b)Internal unmachined surfaces	Aluminum phenolic coating
c)All machined surfaces including dry pocket	VCI oil, wax based coating, or wrapped in VCI paper, VCI plastic, and VCI emitters
d)External unmachined areas exposed to EHC fluid	Epoxy enamel
Shipping method	All openings are protected with hard-board or fiberboard covers. Shipped supported on cushion boards. Waxed or VCI paper is installed at all points of contact between metal and wood.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment.

10. Mid-standard

a)External unmachined surfaces	Alkyd primer
b)Internal unmachined surfaces	Aluminum phenolic coating
c)All machined surfaces	Wax based coating or wrapped in VCI paper, VCI plastic or VCI emitters.
Shipping method	All openings are protected with hardboard covers. Shipped supported on cushion boards. Waxed paper is installed at all points of contact between metal and wood.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment.

11. Main oil tank

a)External surfaces	Alkyd primer
b)Internal surfaces	Epoxy phenolic coating
Shipping method	Level B: Shipped blocked to transportation vehicle and supported on cushion boards. All motors and electrical components are wrapped with water resistant material. Level A: Same as Level B, except pumps and motors shipped separately. Vapor extractor is shipped separately on a skid and protected with poly-backed VCI paper. Covers are bolted over all openings. Vapor phase inhibitor or desiccant placed inside of the tank with humidity indicators installed.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment.

12. Diaphragms & nozzle plates

a)All surfaces including steam path plastic	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI
Shipping method	High-pressure shipped supported on wood skid or blocked on cushion boards. Low-pressure shipped blocked on cushion boards. Waxed or VCI paper is installed at all points of contact between metal and wood.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment. Do not stack. Diaphragms may slide due to lubricating properties of wax based coating.

13. Packing heads

a)All surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
Shipping method	Shipped supported on cushion boards and blocked. Waxed paper is installed at all points of contact between metal and wood.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment.

14. Packing rings

a)All surfaces (diaphragm)	Skin packaged (encased in thermoformed plastic) on heavy cardboard or boxed and protected from mechanical damage by non-hygroscopic dunnage.
b)All surfaces (steam)	Wrapped in cardboard, boxed and protected from mechanical damage by non-hygroscopic dunnage.

15. Nozzle boxes

a)All unmachined surfaces	VCI oil
b)All machined surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
Shipping method	Shipped supported on wooden skids or cushion boards. Waxed paper is installed at all points of contact between metal and wood.
Storage recommendation	All cushion boards should be removed at site to prevent corrosion due to possible moisture entrapment.

16. Journal bearings, thrust bearings, bearing rings

a)Machined surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
b)Unmachined surfaces	Aluminum phenolic coating
c)Horizontal joint	VCI oil

17. Copper-backed thrust plates

Packed in non-hydroscopic dunnage

18. Pads for pad bearings

a)Machined and babbitted surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
Shipping method	Bearings and rings shipped on wood skids. Thrust plates are shipped in special wood box protected from mechanical damage by special packaging.

19. EHC hydraulic power unit

a)External surfaces	Epoxy enamel
b)Reservoir internal surfaces	Unpainted
c)Exposed shafts and couplings	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
Shipping method	Level B: Shipped with a protective covering over unit. Level A: Same as Level B except all motors wrapped with VCI paper and covered with water-resistant material. VCI paper added inside frame. All openings sealed off.

20. EHC power actuators

a)External surfaces in general	Epoxy enamel
b)Machined surfaces of mounting flange	Wax based coating, VCI oil, or wrapped in VCI paper and/or plastic VCI
c)Exposed threads and couplings	VCI oil or wrapped in VCI paper and/or VCI plastic
Shipping method:	Level B: Supported on wood skid or strapped to transporting vehicle. VPI paper in switch box. Level A: Shipped boxed.

21. **Gibs and keys**

Wrapped in VCI paper, VCI plastic or Dip Seal Plastic

22. **Coupling spacer and spacer gears**

a)All surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
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23. **Loose buckets**

a)All surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic, or dry depending upon location of shipment and storage duration.
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24. **Pneumatic control instruments**

Shipping method	Shipped boxed and protected from mechanical damage by non-hygroscopic dunnage.
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25. **Shell studs, nuts, bolts and washers**

Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic

26. **Turning gear**

a)External surfaces	Alkyd primer
b)Internal surfaces	Coated with VCI oil during factory test. Motor and electrical connections covered with water-resistant material.
Shipping method	Level B: Shipped on wood skid. Waxed or VCI paper is installed at all points of contact between metal and wood. Level A: Same as Level B except skids are boxed over. (Motor not removed.)

27. **Lift pump assembly**

- | | |
|---------------------|---------------------------|
| a)External surfaces | Alkyd primer |
| b)Internal surfaces | Aluminum phenolic coating |

28. **Low-pressure expansion joints (inlets)**

- | | |
|-----------------|---------------|
| Shipping method | Shipped boxed |
|-----------------|---------------|

NOTE

Do not paint stainless steel bellows.

29. **Coupling studs**

- | | |
|-----------------|---|
| a) All surfaces | Wrapped in VCI paper and/or VCI plastic |
|-----------------|---|

30. **MHC control mechanisms (contained in standards, on valves and hydraulic enclosures)**

- | | |
|--------------------------------|------------------------------|
| a)External unmachined surfaces | Alkyd primer |
| b)Internal unmachined surfaces | Aluminum phenolic coating |
| c)Machined surfaces | Wax based coating or VCI oil |

31. **Atmospheric relief diaphragm**

Shipped boxed

32. **EHC cabinets and panels**

- | | |
|--------------------|--|
| a)Outside surfaces | ANSI-70 gray air dry enamel or powder coating |
| b)Cables | Packed in drum with desiccant inside. |
| Shipping method | |
| (Mark I) | Circuit boards removed from cabinets and shipped separately in evacuated foil bags. Cabinet and panel shipped in special preservation bag with desiccant inside. |
| (Mark II) | Circuit boards shipped installed in cabinet. (Otherwise same as Mark I) |

33. **Thermocouples**

- | | |
|-----------------|-----------------------------------|
| Shipping method | Wrapped in VCI plastic and boxed. |
|-----------------|-----------------------------------|

34. **Miscellaneous electrical hardware**

Shipping method	Packaged in heavy duty cardboard or wooden boxes with non-hygroscopic dunnage.
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35. **Motors**

See Item 10 - Main oil tank, Item 23 - Turning gear, Item 33 - Vapor Extractor.

36. **Vapor Extractor**

a) External unmachined surfaces	Alkyd primer
b) All machined surfaces	Wax based coating
Shipping method	Level B: On oil tank. Motor covered with water-resistant material. Level A: Separately on a skid and protected with poly-backed VPI paper.

37. **Turbine Supervisory Instruments**

Shipping method	Level B: Shipped on skid wrapped in water-resistant material and covered with hardboard and secured. Level A: Same as Level B except wrapped and heat sealed (includes desiccant and humidity indicators) and crated.
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38. **Permanent Magnet Generator (If Shipped Separately)**

a) Outside surfaces	Epoxy enamel
Shipping method	Wrapped in VCI paper and boxed.

39. **Spiral wound gaskets**

Shipping method	Level B: Shipped on heavy cardboard in wood frame. Level A: Same as Level B except boxed.
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40. **Lifting beam**

Alkyd primer

41. **Slings**

Coiled and shipped on covered skid.

42. **Turnbuckles**

Boxed

43. **Wrenches and tools**

Bare metal surfaces wrapped with VCI paper and/or VCI plastic.

44. **Lagging**

a) Inside surfaces	Alkyd primer
b) Outside surfaces	Alkyd primer
Storage recommendation	Stack with metal side to weather.

45. **Main steam piping**

a) External surfaces	Alkyd primer
b) Machined surfaces	Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic
Shipping method	All openings covered. Shipped blocked to transportation vehicle.

46. **Crossover assembly (fossil)**

a) External surfaces	Alkyd primer
b) Internal surfaces	Alkyd primer or VCI powder
c) Machined surfaces	Wax based coating
Shipping method	All openings covered with hardboard. Shipped bolted and blocked to transportation vehicle.

NOTE

Do not paint stainless steel bellows.

47. **Crossaround piping (nuclear)**

a) External surfaces	Alkyd primer
b) Internal surfaces	Alkyd primer or VCI powder
c) Machined surfaces	Wax based coating
Shipping method	All openings covered with hardboard. Shipped bolted and blocked to transportation vehicle.

48. **Piping-oil, water and secondary steam**

Shipping method	(See Exhibit C.) All piping pickled and oiled. Lube oil piping capped with metal covers or heavy plastic bags and sealed by taping.
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49. **Main steam and combined valve**

a) External unmachined surfaces	Alkyd primer
b) All internal surfaces	VCI oil or VCI paper
c) External machined surfaces	Wax based coating
Shipping method	Inlets and outlets are protected with covers and sealed shut. Valves are blocked externally in the open position.
Storage recommendation	
• Valve body and internals	Upon arrival at site, valves are required to be inspected to ensure the seat is off the disc. A temporary stem block painted yellow should be evident. Valves should be reprotected, resealed and stored indoors. Coat the insides with VCI oil and install VCI emitters on the inside of the protective covers. Emitters are to be wired together and to the cover for positive capture. Label all covers "VCI emitters installed and to be removed prior to installation".
• Valve actuators	If the valves are going to be stored for greater than 6 months, the actuators are to be in the vertical position making sure that any exposed surfaces of the piston rods are protected with preservative.

50. Blowdown, speed matching, and ventilator valves

a) External unmachined surfaces	Alkyd primer
b) All internal surfaces	VCI oil
c) External machined surfaces	Wax based coating
Shipping method	Level B: Shipped on pallet and blocked. Level A: Same as Level B except boxed. Openings protected by hardboard covers.

51. Bypass valve assembly

a) External machined surfaces	Wax based coating
b) Surfaces exposed to EHC hydraulic fluid	Epoxy enamel
c) Surfaces not exposed to EHC hydraulic fluid	Alkyd primer
d) Internal steam surfaces	VCI oil
Shipping method	All hydraulic openings are sealed, steam inlets and outlets are protected with taped-on hardboard covers with VCI paper enclosed. Hydraulic cylinders are assembled to valves. Blocked to transportation vehicle.

52. Air-operated valves

a)Machined parts	VCI oil or wrapped in VCI paper and/or VCI plastic
Shipping method	Level B: Shipped strapped to skid with all openings covered with durable covers bolted or strapped on. Level A: Same as Level B plus additional features that the vendor uses for overseas shipment. (To include internal and unpainted external surfaces coated with a removable preservative.) The valve is boxed and the box waterproofed, desiccant is added in the box with appropriate markings on six sides of the box.
Storage recommendation	Remove all packing to prevent pitting of stem.

53. Crossaround relief valves (nuclear)

a)External unmachined surfaces	High temperature aluminum paint
b)Machined parts	Waxed based coating
Shipping method	Level B: Shipped strapped to skid with all openings covered with durable covers bolted or strapped on. Level A: Same as Level B plus additional features that the vendor uses for overseas shipment. (To include internal and unpainted external surfaces coated with a removable preservative.) The valve is boxed and the box waterproofed, desiccant is added in the box with appropriate markings on six sides of the box.

54. Motor operated valves

a)Machined parts	VCI oil
Shipping method	Level B: Shipped strapped to skid with all openings covered with durable covers bolted or strapped on. Level A: Same as Level B plus additional features that the vendor uses for overseas shipment. (To include internal and unpainted external surfaces coated with a removable preservative.) The valve is boxed and the box waterproofed, desiccant is added in the box with appropriate markings on six sides of the box.
Storage recommendation	Remove all packing to prevent pitting of stem.

55. Vacuum breaker valve

a)Machined parts	VCI oil
Shipping method	Level B: Shipped strapped to skid with all openings covered with durable covers bolted or strapped on. Level A: Same as Level B plus additional features that the vendor uses for overseas shipment. (To include internal and unpainted external surfaces coated with a removable preservative.) The valve is boxed and the box waterproofed, desiccant is added in the box with appropriate markings on six sides of the box.

56. Moisture separators and moisture separator reheaters

a)External unmachined surfaces	Alkyd primer
b)Internal surfaces	Dry nitrogen blanket (see Exhibit B)
c)Machined surfaces	Wax based coating
Shipping method	Shipped on temporary returnable shipping saddles.

57. Moisture separator and moisture separator reheater hangers

Alkyd primer, wax based coating, and anti-seize lubricant.

Shipping method	Shipped in heavy duty water-resistant wooden box.
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58. Moisture separator and moisture separator reheater misc. parts and hardware

Alkyd primer, wax based coating, and anti-seize lubricant.

Shipping method	Shipped in heavy duty water-resistant box.
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59. Steam seal evaporator

a)External surfaces	Alkyd primer
b)Internal surfaces	Dry nitrogen blanket (see Exhibit B)
c)Machined surfaces	Wax based coating

60. Steam packing exhauster

a)External surfaces	Alkyd primer
b)Internal surfaces of water header	Coal tar paint in header and Red Oxide paint on flapper valve.
c)Internal surfaces of shell	Wax based coating
Shipping method	Shipped blocked on wood skid and openings sealed.

61. Steam packing exhauster blower

Shipping method

Level B: Removed from exhausters and shipped on skid

Level A: Same as Level B except boxed.

62. Miscellaneous parts and hardware

Wax based coating, VCI oil, or wrapped in VCI paper and/or VCI plastic

III. RECOMMENDED STORAGE ENVIRONMENTS FOR STEAM TURBINE COMPONENTS

Ideally, steam turbine-generator equipment should be stored indoors in a controlled environment immediately upon receipt at the jobsite. Since this is not always possible, a categorization of *minimum* recommended storage environments is presented in this Part. Basically, all electrical and other delicate equipment is recommended for storage classified as “Indoor Heated”, temperature 60 F to 120 F with relative humidity maintained at less than 70% for all temperatures.

A number of items require shelter during storage but are relatively unaffected by humidity changes. These are classified in the “Indoor Unheated” category. However, when indoor storage facilities are not available, these items may be stored outdoors if weatherproof temporary shelters are employed to provide the same protection afforded by an unheated building. Boxed items should never fall in this category.

As stated in this Part, some components can generally be stored outdoors.

Careful consideration must be given to the selection of storage location for each piece of equipment. The type of equipment, its function, and its susceptibility to degradation from exposure to the elements are basic factors about which the purchaser must be concerned when choosing the optimum location for each item. There are a number of specific precautions that must be taken to ensure a successful storage program. Some of these precautions are:

1. Outdoor storage areas should be well drained and not subject to flooding.
2. Access to equipment for surveillance and maintenance should be provided.
3. Where equipment is supported on timbers with steel shims or pipe stands, neoprene should be used to isolate the support surfaces from the blocking in the contact area.
4. Components should rest on timbers or other supports to keep them above the ground or the floor, at a height to permit visual inspection of all joint surfaces.
5. Equipment should be supported from unmachined or other noncritical surfaces where possible.
6. Care should be taken to ensure that equipment stored outdoors cannot trap and accumulate rain water in concave surfaces or other pockets.
7. Equipment stored outdoors will require less maintenance if it is covered with a waterproof material which allows space for air circulation under it and room for inspection. Proper provision should be made for drainage in the event that the covering should develop a leak.
8. Equipment that requires testing or “exercising” during storage should be located such that the required functions can be performed easily.
9. Exclude wildlife habitation.
10. Remove all cushion boards to prevent corrosion due to possible moisture entrapment and represerve as necessary.
11. Boxed material should always be stored indoors, and upon receipt, plastic covers should be permanently removed.

The following tabulation lists the *minimum* storage environment recommended for all major components.

THE NUMBERED ITEMS LISTED IN THIS PART ARE IN THE SAME SEQUENCE AS PARTS I AND III.

COMPONENTS	MINIMUM STORAGE ENVIRONMENT RECOMMENDED		
	<u>Outdoors</u>	<u>Indoor Unheated</u>	<u>Indoor Heated</u>
1. Assembled section		X	
2. HP and reheat outer shells	X		
3. HP and reheat inner shells		X	
4. LP exhaust hoods	X		
5. LP inner casings	X		
6. Miscellaneous fabricated parts		X	
7. Rotors		X	
8. Foundation and base plates		X	
9. Front standard		X	
10. Mid standard		X	
11. Main oil tank	X (Level B)	X (Level A)	
12. Diaphragms		X	
13. Packing heads		X	
14. Packing rings		X	
15. Nozzle boxes or plates		X	
16. Bearings and bearing parts		X	
17. EHC hydraulic power units		X	
18. EHC power actuators		X	
19. Gibs and keys		X	
20. Coupling spacers, and gears		X	
21. Loose buckets		X	
22. Pneumatic control instruments		X	
23. Shell studs, nuts, bolts and washers		X	
24. Turning gears		X	
25. Lift pumps		X	
26. LP expansion joints		X	
27. Coupling studs		X	
28. MHC control mechanisms		X	
29. Atmospheric relief diaphragm		X	

COMPONENTS	MINIMUM STORAGE ENVIRONMENT RECOMMENDED		
	<u>Outdoors</u>	<u>Indoor Unheated</u>	<u>Indoor Heated</u>
30. EHC cabinets, panels and cables			X
31. Thermocouples		X	
32. Miscellaneous electrical hardware		X	
33. Motors (if shipped separately)			X
34. Vapor extractors (if shipped separately)			X
35. Turbine supervisory instruments			X
36. Permanent magnet generators			X
37. Spiral wound gaskets		X	
38. Lifting beams	X		
39. Slings and turnbuckles		X	
40. Wrenches and tools		X	
41. Lagging	X		
42. Main steam piping	X		
43. Crossover assembly	X		
44. Crossaround piping	X		
45. Piping — oil, water and secondary steam		X (See Exhibit C)	
46. Main steam and combined valves		X (See Part I)	
47A. Blowdown, speed matching and ventilator valves		X	
47B. Bypass valve assembly		X	
48. Air-operated valves		X	
49. Crossaround relief valves		X	
50. Motor-operated valves			X
51. Vacuum breaker valves			X
52A. Moisture separators and moisture separator reheaters	X		
52B. Moisture separator and moisture separator reheater hangers		X	
52C. Moisture separator and moisture separator reheat misc. parts and hardware		X	

COMPONENTS	MINIMUM STORAGE ENVIRONMENT RECOMMENDED		
	<u>Outdoors</u>	<u>Indoor Unheated</u>	<u>Indoor Heated</u>
53. Steam seal evaporators	X		
54. Steam packing exhausters		X	
55. Steam packing exhauster blowers			X
56. Miscellaneous parts and hardware		X	

NOTE

IF COMPONENTS RECOMMENDED FOR INDOOR STORAGE (I.E., MAIN STEAM VALVES, PIPING, ETC.) WILL BE EXPOSED TO A PERIOD OF TEMPORARY OUTDOOR STORAGE, IT IS STRONGLY RECOMMENDED THAT SUCH COMPONENTS BE PROTECTED FROM THE ELEMENTS BY COMPLETELY COVERING THEM WITH WATERPROOF MATERIAL. TO PREVENT CONDENSATION ON THE COMPONENTS, THE WATERPROOF COVERINGS SHOULD BE APPLIED IN SUCH A WAY AS TO ALLOW COMPLETE AIR CIRCULATION AROUND THE COMPONENT.

IV. RECEIVING, SURVEILLANCE AND MAINTENANCE OF STEAM TURBINE COMPONENTS FOR STORAGE

This Part contains recommendations for receiving, surveillance and maintenance of steam turbine components. Since storage conditions at each jobsite can be quite varied, the purchaser must plan a schedule suited to his particular situation. The frequency of inspection and upgrading of the protective packages can be adjusted to fit the conditions, as experience is gained at each storage location.

A. RECEIVING

Damage to the protective materials can occur during transit; thus it is imperative that the parts be inspected, when received, for any type of visible damage or deterioration of the protective materials due to shipment. If required, parts should be cleaned and reprotected before storage.

Upon arrival, all parts shipped by rail transportation should be inspected for signs of damage due to humping (rotors, hoods, stators, fields, etc.). If any damage to parts or skidding is noted, it should be reported immediately to the local GE representative.

All truck shipments of boxed components from Industrial & Power Systems will be tarpaulin-protected at the time of departure. Upon arrival at site, these shipments should be similarly *well tarpaulined*. *At that time, if any damage is noted or the tarpaulin is missing, this should be noted when receipting the bill of lading. The customer or his representative should immediately notify the local GE representative.*

NOTE

It is recommended that steel blocks 6'×12'× 1' with 1/16" neoprene be placed between timbers or pipe stands and the support areas of the shells, hoods, casings, etc.

Upon arrival, all unboxed parts should be inspected for damage or deterioration of protective coverings. Any deterioration of protective coverings on machined surfaces should have the areas cleaned and reprotected before bedding down for storage. If any damage is noted, it should be reported immediately to the local GE representative.

Upon arrival, all boxes should be inspected for external damage and immediately moved indoors. Before storage, all boxes should be opened to verify that the parts have not been damaged and that the protective materials are not wet or otherwise deteriorated. It is desirable, but not essential, that the parts be inventoried at this time. Any damage or deterioration that is noted should be reported immediately to the local GE representative and Exhibit F report form completed and submitted to GE. Following the initial inspection, the covers of the boxes should be replaced to prevent pilferage and sealed with RTV or equivalent to ensure it is moisture proof. VCI emitters may also be installed at this time if required. However, plastic covers should never be replaced.

Components shipped by barge, or by truck over salted roads, require special handling and inspection to counteract the highly corrosive salt-water atmosphere they have been exposed to during transit. It is strongly recommended that the following additional actions be taken on all such shipments immediately after unloading from the carrier:

1. Remove all traces of the salt-water atmosphere which could cause corrosive attack on the components by washing down with liberal amounts of "clean" water.

2. A thorough check should then be made of each component to determine that there are no residual pools of water left in crevices, pockets, etc.
3. On components which have had wooden shipping blocks attached to machined surfaces, the wood blocks should be removed at the earliest opportunity and the machined surface under the block should be cleaned to check its condition. If there are signs of moisture having been in contact with the metal surfaces, they should be cleaned and reprotected with the appropriate preservative.

B. SURVEILLANCE AND MAINTENANCE

A planned program of both surveillance and maintenance on every component is essential in order to properly preserve the equipment during storage periods. The local GE representative can be contacted to assist in preparing a suitable plan.

It is recommended that the purchaser prepare a checklist for each major component, crate, or box in storage. The check list should list the specific points that must be checked at each inspection -for example, the machined surfaces, rotor and field journals, key and deflector fit surfaces, humidity readings, condition of coverings and preservations, etc. The check list should also include a column for the observer to note the existence of any adverse conditions that should be corrected.

The following tabulation can be used as a guide in establishing such a plan. It should be recognized that this tabulation is based upon limited data and *should be used only as a guide*. However, through the application of a proper surveillance and maintenance program, a purchaser should be able to store his equipment for extended periods, provided the recommendations set forth in this publication are utilized.

C. SUMMARY OF RECOMMENDED SURVEILLANCE REQUIREMENTS FOR STEAM TURBINE-GENERATOR COMPONENTS DURING STORAGE (AFTER INITIAL INSPECTION)

This Part contains the *minimum* recommended surveillance frequencies if experience is good. If an item is stored in a wooden crate with VCI the intervals may be extended based upon local conditions. If experience shows conditions not to be satisfactory, the surveillance frequencies should be increased.

THE NUMBERED ITEMS LISTED IN THIS PART ARE IN THE SAME SEQUENCE IN PARTS I AND II.

COMPONENTS	RECOMMENDED MINIMUM SURVEILLANCE REQUIREMENTS
1. Assembled section	Check after arrival, then every 3 months.
2. HP and reheat outer shells	Check after 1 month, 2 months, then every 3 months.
3. HP and reheat inner shells	Check after 1 month, then every 3 months.
4. LP exhaust hoods	Check after 1 month, 2 months, then every 3 months.
5. LP inner casings	Check after 1 month, 2 months, then every 3 months.
6. Miscellaneous fabricated parts	Check after 1 month, then every 3 months.
7. Rotors (including journals and packing fits)	Check and reprotect 3 weeks after arrival, then every 3 months.

COMPONENTS	RECOMMENDED MINIMUM SURVEILLANCE REQUIREMENTS
8. Foundation and base plates	Check after 1 month, 2 months, then every 3 months.
9. Front standards	Check after 1 month, 2 months, then every 3 months.
10. Mid standards	Check after 1 month, then every 3 months.
11. Main oil tanks	Check after 1 month, then check every 2 months. Check humidity indicators and desiccant monthly.
12. Diaphragms	Check after 1 month, 2 months, then every 3 months.
13. Packing heads	Check after 1 month, then every 3 months.
14. Packing rings	Check every 3 months.
15. Nozzle boxes or plates	Check after 1 month, then every 3 months.
16. Bearings and bearing parts	Check after 1 month, then every 3 months.
17. EHC hydraulic power units	Every 2 months rotate pumps and motors by hand and check condition of air dryer desiccant. Every 3 months check gas precharge in hydraulic accumulators. (See GEK-37900)
18. EHC power actuators	Check after 1 month, then every 3 months.
19. Gibs and keys	Check after 1 month, then every 3 months.
20. Coupling spacers and spacer gears	Check after 1 month, then every 3 months.
21. Loose buckets	Check after 1 month, then every 3 months.
22. Pneumatic control instruments	Check after 1 month, then every 3 months.
23. Shell studs and bolts	Check after 1 month, then every 3 months.
24. Turning gears	Check after 1 month, then every 3 months.
25. Lift pumps	Check after 1 month, then every 2 months check and rotate pumps and motors by hand.
26. LP expansion joints	Check every 3 months.
27. Coupling studs	Check after 1 month, then every 3 months.
28. MHC control mechanisms	Check after 1 month, then every 3 months.
29. Atmospheric relief diaphragms	Check every 3 months.
30. EHC cabinets, panels and cables	Check humidity indicator on desiccant preservation bags monthly.
31. Thermocouples	Check after 1 month, then every 3 months.
32. Miscellaneous electrical hardware	Check after 1 month, then every 3 months.
33. Motors	Check after 1 month, then every 2 months check and rotate shaft by hand.
34. Vapor extractor	Check after 1 month, then every 2 months check and rotate fan and motors by hand.

COMPONENTS	RECOMMENDED MINIMUM SURVEILLANCE REQUIREMENTS
35. Turbine supervisory instruments	Check humidity indicator on desiccated preservation bags monthly.
36. Permanent magnet generators	Check after 1 month. Rotate generator by hand, check every 2 months.
37. Spiral wound gaskets	Check after 1 month, then every 3 months.
38. Lifting beam	Check every 3 months.
39. Slings and turnbuckles	Check every 3 months.
40. Wrenches and tools	Check every 3 months.
41. Lagging	Check every 3 months.
42. Main steam piping	Check after 1 month, 2 months, then every 3 months.
43. Crossover assembly	Check after 1 month, 2 months, then every 3 months.
44. Crossaround piping	Check after 1 month, 2 months, then every 3 months.
45. Piping — oil, water and secondary steam	Check after 1 month, then every 3 months.
46. Main steam and combined valves	Check after 1 month, 2 months, then every 3 months.
47A. Blowdown, speed matching and ventilator valves	Check after 1 month, then every 3 months.
47B. Bypass valve assembly	Check after 1 month, then every 3 months.
48. Air-operated valves	Check after 1 month, then every 3 months.
49. Crossaround relief valves	Check after 1 month, then every 3 months.
50. Motor-operated valves	Check after 1 month, then every 2 months operate valves by hand. Store in a position to keep motor and hand wheel in a horizontal plane and limit switch compartment facing up. For storage longer than 12 months, the limit switch, torque switches, seals and gasketed surfaces should be sprayed with CRC #2-26 and CRC Lectra Shield spray.
51. Vacuum breaker valve	Check after 1 month, then every 2 months operate valves by hand and turn motors.
52A. Moisture separators and moisture separator reheaters	Check overall after 1 month, 2 months, then every 3 months. Check nitrogen pressure daily on arrival at storage site and periodically thereafter. The schedule is to be determined after the rate of leakoff is known.
52B. Moisture separator and moisture separator reheater hangers	Check every 3 months.
52C. Moisture separator and moisture separator reheater misc. parts and hardware	Check every 3 months.

COMPONENTS	RECOMMENDED MINIMUM SURVEILLANCE REQUIREMENTS
53. Steam seal evaporator	Check overall after 1 month, 2 months, then every 3 months. Check nitrogen pressure daily on arrival at storage site and periodically thereafter. The schedule is to be determined after the rate of leakoff is known.
54. Steam packing exhaustor	Check after 1 month, 2 months, then every 3 months.
55. Steam packing exhaustor blower	Check after 1 month, then every 2 months. Rotate blower and motor by hand every time unit is checked.
56. Miscellaneous parts and hardware	Check after 1 month, then every 3 months.

V. PROTECTION OF ASSEMBLED TURBINES

A. INTRODUCTION

When a new fossil or nuclear turbine is idle for some time after assembly and prior to start-up, precautions need to be taken to maintain the turbine in good condition through this period. Similarly, precautions need to be taken when in-service turbines are idle for long periods either for inspection, maintenance or some other reason. In this Part, action is recommended to deal with such idle conditions. Nuclear turbines require special attention in this regard, since nuclear stations generally take longer to construct than fossil plants. Thus, the period between assembly and start-up for the nuclear turbine is likely to be longer than for fossil turbines. Consideration must be given to the compatibility of various protective coatings with the feedwater and steam generation systems. These recommendations, therefore, give particular emphasis to nuclear turbines although the principles outlined also apply generally to fossil turbines.

Where recommendations are made regarding the use of specific preservation materials, alternative commercially available materials may be acceptable. However, it is recommended that such alternative materials not be used without prior consultation with GE Company.

These recommendations, while intended to be conservative, do not cover all circumstances met in the field. They should accordingly be adapted to suit individual circumstances. For extended idle periods it may, for example, prove practical to lengthen the time between inspections as time goes on if no difficulties have been experienced.

B. PROTECTION OF NEW TURBINES DURING ASSEMBLY

Factory Applied Coatings

With the exception of the wax based coating used generally to protect machined surfaces of large items, the factory applied coatings may remain on the turbine components as they are being assembled. The recommended wax based coatings materials are all incompatible with both steam and feedwater systems and turbine lubricating oils *and therefore, must be removed prior to assembly*. (Recommendations are available from the local GE representative for the removal of wax based preservative coatings.) All the other factory applied coatings (paints, oil, etc.) are compatible with the turbine steam path and auxiliary systems in which they are applied, and do not need to be removed.

Protection of Steam Path

The wax based coating when applied to turbine steam path components must be removed prior to assembly. If it is required to replace the wax based coating to give protection until startup, a light duty preservative that is low in contaminant levels (sulfur and chlorine) may be used. Total chlorine content is typically less than 100 ppm and total sulfur content is less than 250 ppm. If any doubt exists about materials entering the feedwater or steam generation systems, it is recommended that the condensate from the condenser hotwell be run to waste initially until the system purges itself. The quantity of any temporary preservative that is applied to the turbine steam path should obviously be kept to a minimum consistent with providing proper protection.

If it is considered undesirable to replace the wax based coating with a light duty preservative, and the steam path components are left bare, it is recommended that a warm dry air circulation system be installed as discussed for new or in-service assembled turbines.

Protection of Oil Containing Areas and Lubricating Oil System

The factory protection applied in oil-containing areas is a wax based coating on exposed machined surfaces and a VCI containing turbine lubricating oil on inaccessible areas and in assemblies. The wax based coating must be removed prior to assembly and the surfaces so exposed should be reprotected with a VCI containing turbine lubricating oil. Likewise, the lubricating oil system (piping, etc.) should be fogged with the a VCI containing turbine lubricating oil during assembly. The VCI containing turbine lubricating oil that is used is fully compatible with the turbine lubrication oil. The vapor corrosion inhibitor (VCI) ingredients in the oil make the oil particularly good for use in enclosed spaces such as in the lubricating oil systems.

Protection of Main Steam Valves

Main steam valves are fogged internally with VCI containing turbine lubricating oil before leaving the factory and should be refogged during assembly if a delayed start-up is envisaged. Special attention should be paid to nitrided stems and bushings since these are particularly prone to pitting attack if the turbine is left idle. The VCI inhibitor in the fogging oil is a deterrent to such attack.

Some nuclear main steam valves are fitted with soft packings and corrosion of the valve stem in this area can be a particular cause for concern. This problem is accentuated where the valve stem enters the bottom of the valve casing, thus enabling moisture to collect very readily at the soft packing. These valves are shipped with the soft packings assembled to help preclude the entry of moisture into the valve internals during shipment. When a valve fitted with a soft packing is placed indoors for storage, the soft packing assembly should be unbolted from the valve casing and slid down to the stem coupling. The packing should not be reassembled until just prior to start-up.

Notification of any corrosion or pitting found on valve stems, either under soft packings or otherwise, should be made to the local GE representative for disposition.

Protection of External Parts

The degree of protection required for exposed external parts of the turbine depends very much on local conditions but, in general, some form of light duty preservation should suffice. If additional protection is required, a wax based coating is suitable. The more durable the preservative, the more difficult the subsequent clean-up becomes. For electrical equipment, CRC-2-26 or LPS #1 sprays may be used. Care should be taken not to get the preservative spray on to millivolt contacts or non-pressurized contacts of 12V or less. If contacts do become contaminated, CRC-QD or HF Contact Cleaner or equivalents are two sprays available to remedy the situation.

C. PROTECTION OF NEW OR IN-SERVICE ASSEMBLED TURBINES (ON FOUNDATION)

General

If a new turbine has been properly protected during assembly, minor maintenance will be required for about 6 months of idle time between assembly and start-up. If the main oil tank is not in operation, a VCI containing turbine lubricating oil (or a 50-50 mixture of VCI containing turbine lubricating oil and a mineral oil based lubricating oil additive such as STP Oil Treatment for those bearings with lift pumps) should be injected into the bearings once a month and the turbine turned to replenish the coating in the contact area. Likewise, all electrical motors should be turned by hand once a month.

In the case of in-service turbines or long-term storage units that are idle for long periods, the situation is considerably different from a new unit. The steam path has no protection and the full oil charge, and hydraulic fluid charge, in the case of an EHC turbine, is in place. There may also be cases where a new turbine will have no steam path protection and will have full oil and/or hydraulic fluid charges. In all these cases, special techniques are required to maintain the turbine in good condition if the idle period exceeds two months.

Since nuclear turbines are likely to have longer inspection and maintenance times than fossil turbines, due to their size and to the complexity of the steam generation system, the recommendations give particular emphasis to nuclear turbines although the principles outlined also apply generally to fossil turbines.

Condenser Operation

An otherwise unprotected turbine should not be shut down for more than one month when the condenser or nuclear bypass system is in operation, unless condenser vacuum is pulled and the turbine steam seal system is in operation. In this case the corrosive conditions inside the turbine are greatly reduced due to the lack of oxygen in the internal environment. Any source of steam or water entering the condenser is a cause for concern. When steam blanketing is used for shutdown corrosion protection of the nuclear reheater tubes, the condensate should be returned to the auxiliary steam source without entering the main condenser. Condenser operation without vacuum being pulled and the turbine steam seal system being in operation can cause general corrosion inside the turbine and may also cause corrosion on other important items such as valve stems, bushings, and on internal gibs and keys. If such operation continues for more than one month, all valve stems and bushings should be examined before the turbine is started or restarted. Likewise, monthly inspection of the last-stage bucket region is recommended to ensure that pitting is not taking place. If long term operation of the condenser without vacuum being pulled and the turbine steam seal system being in operation is envisaged, the local GE representative would be so informed as it may prove necessary, for example, to disassemble the combined intermediate valves on nuclear turbines to replace the valves and bushings with temporary blanking fixtures.

Protection of Steam Path

Arrangements should be made to circulate warm dry air through the turbine steam path. A typical arrangement for a nuclear turbine is shown in Figure 1.

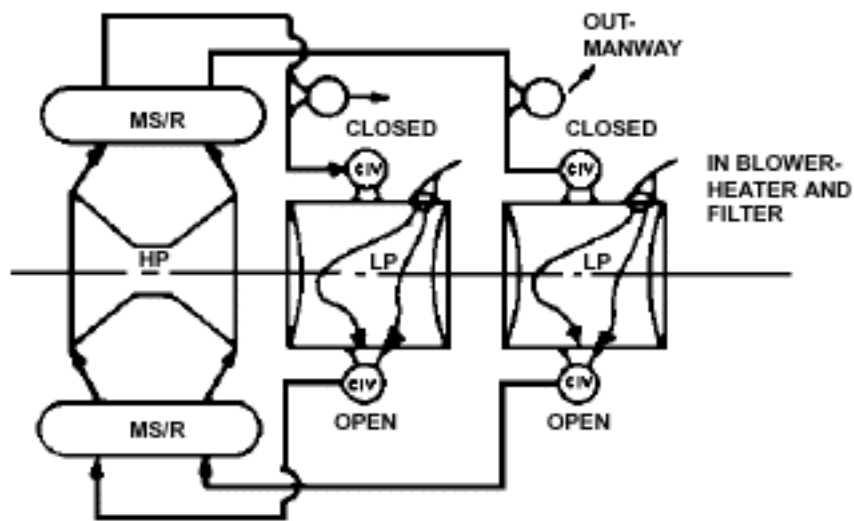


Figure 1. Typical circulating arrangement for a nuclear turbine

With this arrangement, half the combined intermediate valves must be opened by uncoupling their stems. The air should be electrically heated (not direct combustion) and the inlet flow and temperature should be such that the lowest temperature inside the turbine (namely, at the outlet point or points) is 10 F or more above ambient. This should ensure that the air is above its dew point at all places inside the turbine.

Blowers/heaters should be used in conjunction with dehumidifiers to maintain as low a relative humidity inside the turbine as possible. (It is generally accepted that corrosion on steel is minimal below about 30 percent relative humidity.) The blowers/heaters should also be fitted with filters to prevent particulate matter fouling the turbine steam path. The filters should be changed at a frequency depending on local conditions. In addition to the warm air circulation, the following steps should be taken:

1. Drain condenser hotwell and all feedwater heaters, or isolate feedwater heaters from turbine.
2. Run steam packing exhauster blower. (It may prove advantageous to open the butterfly valve upstream of the steam packing exhauster wider than the normal operational setting provided that the steam packing exhauster motor is not overloaded by doing so.)
3. Open all turbine steam drains.
4. Close vacuum breaker valve or valves and feedwater heater vents (unless feedwater heater is isolated from turbine).

Operation of Lubricating Oil System

It is recommended that the lubricating oil system be operated for at least 1/2 hour per week and that the turbine be put on turning gear for about five minutes during this 1/2-hour period. The discharge pressures from the lift pumps (if so provided) should be noted at this time. Falling pressure with time can indicate lift pump wear. If local conditions are such that condensation or other corrosive conditions are likely to exist in the lubricating oil system, then the system should

be operated more frequently than 1/2 hour per week, thereby keeping the oil warm and minimizing the likelihood of condensation. In severe cases consideration should be given to using a vapor space-inhibitor type of oil, a number of which are now commercially available. These oils emit a vapor when kept at a temperature above about 80 F, the vapor providing corrosion protection to those surfaces not directly in contact with the oil.

Operation of Control System

The hydraulic control system on the turbine, either MHC or EHC, should be operated weekly for a minimum period of two hours and all the control mechanisms and main steam valves should be stroked at this time. Particular note should be made of stem condition when stroking the main steam valves, looking for signs of pitting or general corrosion.

NOTE

For extended idle periods the soft packings on valves so fitted should be disassembled as described earlier for the protection of new turbines during assembly.

During this weekly testing of an EHC turbine the EHC electronics should be fully energized for a minimum period of four hours.

In order to minimize the risk of water contaminating the hydraulic fluid of an EHC turbine during the idle periods, the cooling water supply to the fluid coolers on the EHC hydraulic power unit should be shut off and the water pressure in the coolers relieved. The water supply should be turned on only if necessary to maintain the fluid temperature below 125 F when the hydraulic power unit is actually running. It should be shut off again and the water pressure in the coolers relieved when the EHC hydraulic power unit is shut down.

Motors and air operated valves associated with nuclear reheaters, steam seal systems, steam drain systems and similar systems should also be stroked weekly.

During the idle period of an EHC turbine, the EHC control cabinet and panel(s) should be maintained in a clean and dry environment and kept at a temperature of 50 F to 104 F. The equipment should be kept locked except when required to be opened for inspection.

Periodic Inspections

The following periodic inspections are recommended during the idle period:

1. Last-Stage Buckets — The last-stage buckets should be inspected monthly for signs of pitting attack.
2. Gibs and Keys — All gibs and keys locating the low-pressure inner casing inside the exhaust casing should be examined monthly for signs of corrosion. It is essential that these gibs and keys permit free sliding when the turbine is started up.
3. Lubricating Oil — The lubricating oil should be analyzed for water content, corrosive constituents, and corrosion inhibitor content, and should be thoroughly purified prior to the idle period and every six months thereafter.

4. Journal Bearings — One journal bearing should be inspected every two months. The inspections should be alternated so that a different bearing is inspected each time. The last inspection before start-up should include the thrust bearing and one of the adjacent journal bearings.
5. EHC Hydraulic Power Unit and Fluid — The EHC hydraulic power unit should be maintained throughout the idle period generally in accordance with GEK-46355 with particular attention being given to the air dryer. The hydraulic fluid should be analyzed per GEK-46357 prior to the idle period and every month thereafter. Particular attention should be given to water content.
6. Valves — Certain valves should be disassembled for inspection at regular intervals — every two months, initially. After the second or third inspection the intervals may be lengthened or shortened depending on the experience gained. The following inspection sequence, typical of a nuclear turbine, is recommended:
 - Stop Valve #4, Control Valve #1, #2 or #3 and one Moisture Separator Drain Valve;
 - One Combined Intermediate Valve and one Bypass Valve;
 - Stop Valve #1, #2, or #3, Control Valve #4 and the Steam Seal Feed Valve;
 - One Combined Intermediate Valve, one Bypass Valve and one Reheater Heating Steam Supply Valve; etc.

Combined Cycle Turbine:

- One Combined Stop / Control Valve
 - One Combined Reheat Valve
7. “Corten” Reheater Tubing — When moisture separator reheaters are fitted with ferrous “Corten” type reheater tubing, the undersides of the tube bundles should be periodically inspected, (as a minimum prior to start-up) to insure that the finned surfaces of the tubing are in good condition and that “rust bridging” of the fins is not taking place due to the presence of moisture. Powdery oxide on the fins is a normal condition and will not cause any problems. “Rust bridging” is, however, a serious condition and if allowed to become extensive, will shorten the useful life of the reheater tube bundles.

D. PROTECTION OF A TYPICAL HP/IP ASSEMBLY FOR LONG TERM STORAGE (INDOORS)

General

An assembled HP/IP turbine with attached front standard is typically shipped with the internal machined surfaces preserved with VCI oil. In order to ensure adequate long term corrosion protection, additional steps need to be taken with the intent of having the components airtight as shown on Figure 2, and the following:



Figure 2. TYPICAL HP/IP ASSEMBLY

1. HP/IP Assembly
 - a. Install VCI emitters in all lower steam pipe cap locations, including steam seal and lube oil pipe. Emitters are to be wired together and to the pipe cap for positive capture. Label all caps “VCI emitter installed and to be removed prior to installation”. Seal cap so it is moisture proof.
 - b. Seal crossover cover to casing using a gasket, Permtex or equivalent and tape edges.
 - c. Seal casing to rotor junction inlet & exhaust end, typically using tape or gasket material.
 - d. Ensure all casing openings have been capped and sealed (Borescope access, pressure tap etc).
2. Front Standard Assembly
 - a. If inspection shows any moisture or corrosion, then remove journal bearing and coat turbine rotor with TECTYL 506. This typically requires removal of the standard upper half.
 - b. Coat all internal machined surfaces with CORTEC 386 GEN or a light coating of TECTYL 506.
 - c. Install VCI emitters to inside of cover. Emitters are to be wired together and positive captured. Label cover “VCI emitters installed and to be removed prior to installation”.
 - d. Seal the rotor to front standard gap at the oil deflector.

E. PROTECTION OF TURBINE DURING CHEMICAL CLEANING OF CONDENSER/FEEDWATER SYSTEM

The condenser/feedwater system is sometimes chemically cleaned either when the turbine is in the final stages of assembly or completely assembled. The chemical cleaning agents used are usually rather strong and are of such a nature that neither they nor their vapors should be allowed to contact the highly stressed parts of the turbine. So doing would expose these components to the risk of stress corrosion cracking during subsequent operation. It is *essential* that the condenser/feedwater system be very carefully isolated from the turbine during the chemical cleaning process. All extraction lines should be valved shut and preferably be vented between the valve and the turbine. Turbine steam drains entering the condenser should also be isolated and a vapor barrier should be installed in the low-pressure exhaust hood(s) or condenser neck(s) to isolate the low-pressure turbine(s) from the condenser. This barrier can be a relatively simple structure using heavy gauge plastic sheet. If any doubt exists about the isolation arrangements, clean, warm air should be circulated through the turbine during the chemical cleaning operation to purge any possible leakage and prevent any condensation taking place inside the turbine.

VI. EXHIBIT A - SOURCES FOR PROTECTIVE MATERIALS FOR STEAM TURBINE COMPONENTS

PERMANENT PROTECTIVE PAINTS

DESCRIPTION	SOURCE
Alkyd Primers	
<i>C 1815-B (turbine grade) or 2733 (turbine grade) beige water reducible alkyd primer</i> A beige colored water reducible alkyd primer, contaminant level controlled for steam containing areas.	Glyptal, Inc. 305 Eastern Ave. Chelsea, MA 02150 or C.A. Reeve Paint Co. 619 W. Fayette St. Syracuse, NY 13204
<i>AD 15001 alkyd primer</i> A solvent based rust inhibiting phenolic modified alkyd primer. Generally used as a primer on exterior surfaces.	C.A. Reeve Paint Co. 619 W. Fayette St. Syracuse, NY 13204
Aluminum Phenolic Coating	
<i>3177-NS or HTA-297/298</i> A solvent based oil resistant paint generally used on all unmachined surfaces in oil containing areas.	C.A. Reeve Paint Co. 619 W. Fayette St. Syracuse, NY 13204 or International Paint Co. 400 S. 13th St. Louisville, KY 40203
Epoxy Enamel Coating	
<i>Beige epoxy enamel C-2459, 4015-NS, or 890</i> An extremely hard paint used in heavy-duty applications or where the surface is likely to become contaminated with oil or EHC hydraulic fluid. Conventional paints are attacked by these fluids.	Glyptal, Inc. 305 Eastern Ave. Chelsea, MA 02150 or C.A. Reeve Paint Co. 619 W. Fayette St. Syracuse, NY 13204 or Carboline Co. 350 Hanley Industrial Ct. St. Louis, MO 63144
<i>Bitumastic paint #50</i> A black tar product used to protect cooler water boxes on lube oil and steam packing exhausters coolers.	Carboline Co. 350 Hanley Industrial Ct. St. Louis, MO 63144
<i>#7813-825 high temperature aluminum paint</i> <i>#7813-825 or equivalent. For use on components subject to high temperatures. (Crossaround relief valve externals.)</i>	Raffi and Swanson 100 Eanes St. Wilmington, MA

TEMPORARY PROTECTIVE COATINGS

DESCRIPTION	SOURCE
<i>Shell 32 VSI or Mobil Vaprotec Light</i> A VG-32 turbine lubricating oil containing vapor corrosion inhibitors (VCI) that makes the oil particularly good for use in enclosed spaces. Major characteristic is the lack of metallic additives, making it fully compatible with regular turbine oils. It has low contaminant levels and is generally innocuous in small quantities in feedwater systems. Used where heavy-duty contact preservatives would be difficult to remove since the oil need not be removed. Will not tolerate outdoor exposure.	Shell Oil Company or Mobil Oil Co. 3225 Gallows Rd. Fairfax, VA 22037
<i>Tectyl 810.</i> Used as a water soluble oil dip for lubricating oil and secondary steam piping.	Daubert Chemical Co. 4700 S. Central Ave. Chicago, IL 60638
Wax based coatings	
<i>Tectyl 506.</i> Used on exposed machined surfaces.	Daubert Chemical Co. 4700 S. Central Ave. Chicago, IL 60638
Asphalt based coating	
<i>Tectyl 891.</i> Used as outer coating on journals and thrust collars and other heavy-duty applications such as the support areas of shells, exhaust hoods and inner casings. Shield from direct sunlight to prevent crazing and cracking of hardened Tectyl.	Daubert Chemical Co. 4700 S. Central Ave. Chicago, IL 60638
<i>Tectyl HPS</i> Solvent designed for the dilution and removal of Tectyl coatings.	Daubert Chemical Co. 4700 S. Central Ave. Chicago, IL 60638
Dessicant	
<i>Desiccant MIL-D-3464 and General Spec. MIL-P- 1 16. (Similar to Humi Sorb)</i> Used where humidity control is required.	Engelhard Corp. 70 Wood Ave. Iselin, NJ 08810
VCI paper Vapor corrosion inhibitor (VCI) treated papers and plastics used for wrapping parts and inserted into enclosed spaces for corrosion protection.	Daubert Coated Products One Westbrook Corporate Center Weschester, IL 60154
<i>Permacel P-306</i> A black heavy-duty plastic film tape having the property of removal from surfaces cleanly after long-term outdoor exposures. Used on machined surfaces to cover inaccessible areas such as small or blind holes that are themselves protected by a light-duty, contact preservative.	Permacel P.O. Box 671 New Brunswick, NJ 08903

DESCRIPTION	SOURCE
<i>CRC #2-26 spray</i> For use on electric contacts of "Limitorque" valve controls. Provides 1-2 years protection. (Does not have to be removed prior to use.)	CRC Industries 885 Louis Dr. Warminster, PA 18974
<i>CRC Lectra shield spray.</i> For use on electric contacts of "Limitorque" valve controls. Provides 2-5 years protection. (Remove with petroleum spirits prior to use.) Compatible with CRC #2-26.	CRC Industries 885 Louis Dr. Warminster, PA 18974
<i>Nitrogen.</i> Used in moisture separators, moisture separator reheaters, steam seal evaporators and drain tanks.	Any source of dry nitrogen. 99.5% pure with a dew point of -60 F or below.
<i>Snoop or Leak-Tec.</i> A soap solution used for check for nitrogen leaks on the moisture separator and moisture separator reheaters.	Nupro Co. 4800 E. 345th St. Willoughby, OH 44094 or American Gas & Chemical, Inc. 220 Pegasus Ave. Northvale, NJ 07647
<i>Texaco cup grease #2 or #3, or Mobil grease #2</i> Used to fill and seal small drilled and tapped holes in support surfaces which are blanked-off by the support blocking and not provided with drainage.	Texaco 2000 Westchester Ave. White Plains, NY 10650 or Mobil Oil Co. 3225 Gallows Rd. Fairfax, VA 22037
<i>Marine lube "A" grease.</i> A heavy duty water resistant grease used as a sealant on main-steam valve stems.	Fiske Bros. Refining Co. 129 Lockwood St. Newark, NJ 07105
<i>Grade C Paper - Milpack #12 (Waxed paper)</i> MIL-B-121, Grade C, Type 1, Class 2.	Ludlow Corp. 2 Tyco Park Exeter, NH 03833
<i>Fel Pro N5000 or N7000 nuclear anti-seize lubricant.</i> Used as a lubricant and anti-seize on moisture separator, moisture separator reheater hanger threads and nut and bolt threads. (N7000 for temperatures to 1000F).	Fel-Pro Chemical Products 7450 N. McCormick Blvd. P.O. Box 1205 Skokie, IL 60076-8103
<i>Dip Seal Plastic #DS300</i> Used as a hard coating for corrosion protection on gibs & keys, nuts & bolts.	Dip Seal Plastics Inc. 2311-23rd Avenue Rockford, IL 61101
<i>VCI 386 GEN (CORTEC)</i> Water based, air dry barrier for protection of multi-metals	Connecticut Packaging Mtls Inc. 85 South Satellite Rd. South Windsor, CT 06074 (860)(817-7000)

DESCRIPTION	SOURCE
Daubrite VCI Emitter Corrosion preventative device designed for inside packaging environments and enclosures	Daubert VCI, INC. 1333 Burr Ridge Parkway Burr Ridge, IL 60521-6423
CORTEC V _p Ci Emitter Corrosion preventative device designed for inside packaging environments and enclosures	CORTEC INC. 4119 White Bear Parkway St. Paul, MN 55110

NOTE

Before application of any preservatives, the surfaces must be thoroughly cleaned. Contact the local GE representative for cleaning and preservative application procedures.

NOTE

Some materials listed in Exhibit A, and Part 1 are flammable. Appropriate environmental, health and, safety precautions should be followed for all materials including proper disposal of chemicals. Material Safety Data Sheets should be consulted for specific information.

VII. EXHIBIT B - STORAGE RECOMMENDATIONS FOR MOISTURE SEPARATORS, MOISTURE SEPARATOR-REHEATERS, AND STEAM SEAL EVAPORATORS

This Exhibit contains storage recommendations for moisture separators (MS's), moisture separator-reheaters (MSR's), and steam seal evaporators (SSE's).

This storage procedure gives required protective measures which are necessary to ensure the stored equipment is suitable for eventual installation.

A. CORROSION PROTECTION BEFORE SHIPMENT

These vessels are hydrostatically tested with an inhibited water. After the factory hydrostatic test, the internals are cleaned and dried. All chambers are then charged with dry nitrogen to prevent corrosion during transit and storage.

B. STORAGE AND CORROSION PROTECTION DURING STORAGE

If storage is required, either indoors or outdoors, a well tamped and suitably reinforced level area should be provided on which the vessel may rest on its saddles or skids. In the event that the vessel is to be stored outdoors for more than six months, it should be protected from the environment. The type of protection to be employed is dependent upon the climatic conditions existing at the storage site. Upon request, GE Company will make specific recommendations to suit the individual situation.

NOTE

Moisture separator-reheaters are shipped from the factory on shipping saddles because of railroad clearance limitations. The vessels should be transferred to their site-saddles either during or after unloading. The shipping saddles should then be returned to the factory.

Special Precautions/Restrictions

These vessels are filled with nitrogen; therefore, safety precautions are necessary. Nitrogen has a suffocating effect if inhaled, and accordingly, should be vented to the *outside atmosphere*.¹ Also, when the nitrogen is adjusted or eliminated from the vessels, the nitrogen should be vented to the *outside atmosphere*.¹

Once the vessels have been purged of the nitrogen, no personnel should enter a chamber(s) until ventilating blowers have been in operation for at least two hours for MS's, MSR's, and SSE's.

Reference should be made to Section V of this Exhibit for purging instructions to ensure that all areas are properly ventilated.

Precautions That Should Be Taken Upon Arrival At Jobsite

1. The necessary steps should be taken to protect the vessel from the environment if long-term storage is anticipated.

¹Outside atmosphere means *outdoors* of any building or enclosure.

2. Precautionary steps should be taken to prevent water accumulation on any external parts, and hence corrosion of such parts.
3. All external surfaces, including threads, should be checked monthly for corrosion. In the event excessive corrosion occurs, the local GE representative should be contacted for instructions. However, if paint has been removed or only light corrosion exists, the paint should be replaced as follows:
 - a. The surface to be repainted should be wire brushed clean of loose paint and any accumulated rust.
 - b. Spray or brush one coat of alkyd primer as required. *Do not paint threads.*
 - c. Allow to dry sufficiently for recoating.
 - d. Spray or brush on one coat of alkyd primer as required. *Do not paint threads.*
 - e. Allow to dry sufficiently for recoating.
 - f. Spray or brush two final coats of alkyd primer. Final dry film thickness should be a minimum of 4.5 mils (114 microns)
 - g. Allow to dry thoroughly.

CAUTION

- 1) It is recommended for painting that the surface temperature be a minimum of 60 F. A risk of poor paint adhesion is taken if the surface temperature is less than 60 F during the painting and drying process.
- 2) When the relative humidity is high, as during wet or damp weather or at water side installations, longer drying times must be observed. In many cases a period up to 72 hours is required for thorough drying of a multiple coat paint system.

NOTE

The environmental condition in the applicable storage area must be evaluated to determine the extent of protection required. It is the responsibility of the purchaser to study conditions and take the required steps to achieve the above requirements. Guidance may be obtained from the GE Company if the purchaser requires assistance.

Monitoring the Nitrogen Blanket

It is important that the nitrogen pressure remain above atmospheric at all times. This will prevent the influx of air which would reduce the efficiency of the nitrogen blanket. The initial pressurization is about 10 psig.

For the purpose of monitoring and/or adjusting the nitrogen pressure, a pressure gauge and a valved connection is located on each chamber and each vessel as follows:

1. Two-stage MSR's:

Shell side, first stage reheater tube side and second stage reheater tube side.

2. Single-stage MSR's:

Shell side and reheater tube side.

3. MS's:

Shell side.

4. SSE's:

Shell side and evaporator tube side.

The nitrogen pressure in the chamber(s) should be checked upon arrival at the site. It should then be checked weekly. The nitrogen should not be allowed to fall below 6 psig and should preferably be kept around 10 psig. Pressure in excess of 10 psig caused by upward changes of ambient temperature need not be corrected downward unless the pressure exceeds 14 psig.

It is recommended that all inspections, repairs, or nitrogen adjustments be permanently recorded and maintained by the purchaser.

In the event a vessel arrived at the site with a nitrogen pressure below 6 psig, the vessel should be recharged with dry nitrogen to 10 psig and checked for leaks as explained in Section IV of this Exhibit.

Blanket Leakage

If regular recharging of the nitrogen blanket becomes necessary to sustain a minimum of 6 psig nitrogen pressure and leakage is suspected in a chamber(s), a check for leaks should be made in the following sequence:

1. All threaded connections
2. All manway gasket seats
3. All welded shipping covers and in particular the shell inlet and outlet nozzles.
4. All shell welds and penetrations

A check for gas leaks may be conducted as follows:

1. Remove pipe plug from end of gas charging valve in suspect chamber. Be sure valve is closed prior to removal of plug.
2. Connect the nitrogen bottle(s) to the valve and pressurize to 10 psig.

3. With either a paint brush or squirt dispenser, apply a soapy water solution and sequence check the areas outlined above. A liquid soap solution may be used either as purchased or diluted no more than 50 percent with water. The following soap solutions may be used:

SNOOP
Nupro Co.
4800 E. 345th St.
Willoughby, OH 44094

Leak-Tec
American Gas & Chemical Inc.
220 Pegasus Ave.
Northvale, NJ 07647

4. Rinse off soap solution completely after testing.

In the event a leak is detected in a threaded connection, the connection should be tightened and monitored for a period of four hours. The same procedure should be used with a leaking manway gasket seat; however, the bolts should be torqued in accordance with the manway closure procedure. (See Volume IV of the Turbine Instruction Book.) If a leak in a threaded connection cannot be stopped, the local GE representative should be contacted for instructions.

Should a leak be detected in a welded joint, the local General Electric representative should be notified so that the proper repair procedure may be determined.

Repairs to welded joints should not be effected at the storage site without GE Company's guidance for the following reasons:

1. A repair to a welded joint requires removal of the nitrogen blanket from the chamber concerned and subsequent purging before allowing entry into the vessel. (See Section V of this exhibit.)
2. The MSR's, MS's, and SSE's are ASME Boiler and Pressure Vessel Code certified units, and repairs and alterations require the approval of the National Board of Boiler and Pressure Vessel Inspectors, national and local jurisdictions.

Purging the Nitrogen

It is imperative that no personnel be allowed to enter the MSR's, MS's or SSE's until both tube side and shell side nitrogen blankets have been purged.

The nitrogen blanket should be removed by releasing the nitrogen to the outside atmosphere ²and then evacuating the shell and tube side of nitrogen by connecting a vacuum pump to the charging/purging connection and evacuating to at least 29" of Hg. vacuum to the outside atmosphere. Once the nitrogen is removed (one evacuation cycle by the vacuum pump is sufficient, ambient air should be allowed to enter the vessel. (See Section I of this Exhibit.)

Following the nitrogen purge, in the interest of safety, no personnel should enter a chamber(s) until ventilating blowers have been in operation for at least two hours for MS's, MSR's and SSE's.

²Outside atmosphere means outdoors of any building or enclosure.

For MS's, the chamber head of the front bulkhead is essentially isolated from the main shell chamber. For ventilation purposes, both of these chambers should be ventilated individually using the front access cover and main shell manways respectively.

For SSE's, put an exhauster in the manway openings and blow oil-free air through the feed connection.

For single stage MSR's, the chambers ahead of the front bulkhead and behind the rear bulkhead are essentially isolated from the main shell chamber for ventilation purposes. Both of these chambers should be ventilated using the front start-up drain and the rear access manway.

It should be noted that, for two-stage MSR's, the chambers ahead of the front bulkhead and behind the rear bulkhead are essentially isolated from the main shell chamber for ventilation purposes. These three chambers should be ventilated individually using the front and rear access covers and the main shell manways respectively.

The reheater tube bundles should be ventilated through the heating steam inlet and condensate drain nozzles or through the respective tube side access manways.

The SSE tube side should also be ventilated through the header inlet and outlet connections.

In the event a vacuum cannot be drawn after the chamber(s) of the vessel has been depressurized, the local GE representative should be contacted for instructions.

Inspection Plan

It is recommended that units covered in this exhibit be inspected to the requirements of this publication. An inspection should be conducted upon arrival and recorded on a copy of form (Exhibit E). The frequency of subsequent inspections should be in accordance with Part III of this publication. Results should be recorded on a copy of form (Exhibit F) and forwarded after each inspection as noted.

Corrosion Protection After Installation and Prior to Start-Up

If the period of time between installation and start-up is likely to exceed three months or if the environment within the equipment is likely to be humid so as to encourage condensation, the inside of the equipment should be protected from corrosion by the circulation of clean warm dry (preferably dehumidified) air. This can be done in conjunction with a total corrosion protection system for the turbine-generator steam path (see Part IV of this Exhibit), or individually using the access manways by using electrically powered dehumidifiers placed inside the equipment.

These corrosion protection precautions are particularly important for moisture separator-reheaters fitted with ferrous "Corten" type reheater tubing.

Condensation on this type of tubing, in conjunction with the oxygen of an atmospheric environment, can cause rapid corrosion of the tubes and lead to "rust bridging" between the fins on the external surfaces of the tubes. This type of corrosion buildup is a serious condition and will shorten the life of the reheater tube bundles if allowed to develop to any great extent.

VIII. EXHIBIT C - CLEANING, PROTECTION AND SHIPPING PREPARATION FOR OIL, WATER, AND SECONDARY STEAM PIPING**A. PREPARATION OF PIPING**

Station piping is prepared for shipment from the vendor by pickling and oiling. The outside of all guard piping and all individual piping (except that destined for use inside larger oil piping) is painted with an alkyd primer. The inside of this piping will be oil coated. However, the smaller piping inside the guard piping, if shipped separately, is painted with an aluminum phenolic coating.

Lube-oil system piping is then capped with tightly fitting metal caps overall openings and the ends of the caps sealed with tape. Large diameter guard piping shipped as subassemblies (with smaller diameter piping placed inside the larger piping and protruding outside the larger piping) has a heavy-duty bag placed over the ends of the pipe assemblies, steel banded and sealed with tape.

B. CONTAINERIZATION OF PIPING

In order to insure that the piping remains clean during shipment, it is placed in wooden containers. These are constructed of heavy timber (steel rod reinforced) with plywood sides that extend 4 feet up from the container floor. The top portion of the sides is left open to facilitate loading. After loading, a water resistant plywood cap is fastened in place. This is covered with heavy plastic which extends down the sides to cover the open area and is secured in place with wooden strips.

The normal shipping container will be made approximately to the dimensions shown below. However, some special boxes for awkward shaped sections may also be required.

Normal Box Size

Length — 32 feet

Width — 8 feet

Depth — 6 feet, 8 inches

C. PROCEDURE FOR RECEIVING AND PROTECTION AT DESTINATION

When the piping boxes arrive at the jobsite, the following is recommended:

1. Inspect shipping container for damage. If structural damage is found, damage claims should be filed. Steps should also be taken to guard the piping against corrosion. This can be done by resealing the box and storing the piping indoors in a clean dry place. Plastic cover should be permanently removed.
2. It is strongly recommended that the piping boxes be stored inside as soon as possible. Experience has shown that it is very difficult to maintain the weatherproof integrity of the pipe boxes when they are subjected to the many unknown variables in an outside storage area. Surveillance of the equipment should be conducted according to the schedule in Part III.

D. FURTHER PRECAUTIONS

A planned program for maintaining the piping in a clean condition during installation is also necessary to ensure a clean lubrication system. The many variables that exist at each installation prevent the recommendation of protective measures to apply for each case. However, generally each purchaser should consider the length of the storage and installation, the climatic conditions that will exist, and the condition of the piping as installed in evaluating the need for taking protective measures to minimize the danger of extensive rusting and scaling of the piping. It generally requires less effort to prevent rusting and contamination during storage and installation than to remove these products by extensive flushing later. The use of any inhibitors or coatings other than those described in this Section should be referred to the local GE representative for evaluation for compatibility with the lubricating oil before use.

IX. EXHIBIT D - MOISTURE SEPARATOR, MOISTURE SEPARATOR REHEATER ARRIVAL REPORT

PURCHASER _____

STATION _____

TURBINE NO. _____ MODEL NO. _____

DATE _____ 19 ____

NITROGEN BLANKET PRESSURE

Shellside _____ psi

1st Stage Tube Bundle _____ psi

2nd Stage Tube Bundle _____ psi

CONDITION OF SHIPPING COVERS _____

NOTE: Shell outside nozzle should have plastic sheets taped in place to exclude standing water.

CONDITION OF PAINT _____

Complete upon arrival and submit to the local GE Company representative, who will forward same to Mgr., Steam Turbine Installations,
GE Company, CSD, Bldg. 36-619, Schenectady, NY 12345.

X. EXHIBIT E - MOISTURE SEPARATOR, MOISTURE SEPARATOR REHEATER STORAGE MONITORING REPORT

PURCHASER _____

STATION _____

TURBINE NO. _____ MODEL NO. _____

DATE _____ 19 _____

NITROGEN BLANKET PRESSURE

Shellside _____ psi

1st Stage Tube Bundle _____ psi

2nd Stage Tube Bundle _____ psi

CONDITION OF COVERS OR PLASTIC SHEET ON SHELL OUTLET NOZZLE _____

NOTE: Shell outside nozzle(s) should be covered so as to exclude standing water.

CONDITION OF PAINT _____

Complete once a month by storing agency and submit to the local GE Company representative, who will forward same to Mgr., Steam Turbine Installations, GE Company, CSD, Bldg. 36-619, Schenectady, NY 12345.

XI. EXHIBIT F - MATERIAL RECEIPT PACKAGE INSPECTION REPORT

PURCHASER _____

STATION _____

TURBINE NO. _____ ICN _____

CASE# _____ DATE _____ 19 ____

CONDITION OF CASE AT ARRIVAL?

WAS MATERIAL RECEIVED DAMAGE FREE? CORROSION FREE?

DID THE MATERIAL ON THE PACKING LIST MATCH THE MATERIAL IN THE CASE? WERE THE COUNTS CORRECT?

DID THE CASES ARRIVE WITH ADEQUATE MARKINGS? PAPERWORK? WERE THE DIMENSIONS AND WEIGHTS CORRECT?

Complete upon arrival and submit to the local GE Company representative, who will forward same to Mgr., Steam Turbine Quality Assurance, GE Company, Bldg. 273-290, Schenectady, NY 12345.



GE Power Systems

*General Electric Company
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