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TECHNICAL SPECIFICATION

FOR

MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION

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 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 1 of 8
	TECHNICAL SPECIFICATION FOR MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION	Rev. No. : 0

1.0 SCOPE

This specification covers the procedure for magnetic particle and liquid penetrant examination of Steam Generator /Pressure Vessel components and welds. This procedure covers the minimum requirements, ASME Section V and other reference codes & standards to be referred for other details.

This specification is applicable for projects beyond RAPP-7&8.

2.0 CONTENTS

The requirements of this Specification are presented under the following headings:

	<u>Section</u>
Scope	1.0
Contents	2.0
Surface Condition	3.0
Magnetic Particle Examination	4.0
Liquid Penetrant Examination	5.0
Lighting Conditions	6.0
Acceptance Standards	7.0
Procedure Qualification	8.0
Personnel Qualification	9.0
Post Cleaning	10.0
Report	11.0

3.0 SURFACE CONDITION

Surface preparation by grinding or machining or by other method may be employed where surface irregularities may mask indications of unacceptable discontinuities.

	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 2 of 8
	<u>TECHNICAL SPECIFICATION FOR</u> <u>MAGNETIC PARTICLE AND</u> <u>LIQUID PENETRANT EXAMINATION</u>	Rev. No. : 0

The surface to be examined and all adjacent areas (at least 25 mm from either side) shall be dry and free from any dirt, lint, scale, rust, welding flux, weld spatter, grease, oil etc. These extraneous matters could obscure surface openings or otherwise interfere with examination.

The surface to be examined shall be cleaned with detergents, organic solvents, de-scaling solutions or paint removers. Degreasing and ultrasonic cleaning may be employed to increase cleaning efficiency.

The surface finish for proof machined items shall be better than 6.3 microns. For rolled sheets, surface finish of less than or equal to 10 μm is required.

4.0 MAGNETIC PARTICLE EXAMINATION

4.1 This method involves the magnetization of an area to be examined and the application of ferromagnetic particles to the surface. The particles gather at areas of magnetic flux leakage and form indications characteristic of the type of discontinuity detected.

4.2 Magnetization shall be done by direct or half wave rectified current. Use of A.C./Yoke method requires specific approval of the purchaser. Magnetization must be done in two directions as far as possible, at an angle of 90° to each other. If the source of magnetizing current with an open circuit voltage is more than 25 volts, Vanadium steel or aluminum, rather than copper tipped prods are recommended, to avoid copper penetration.

4.2 Field Intensity

The field intensity should range between 25 and 40 oersteds during the testing, and shall be checked during each variation of test equipment, wall thickness and geometry of the components. The field intensity shall be measured using suitable device. Estimation of field intensity based on current and prod spacing is not acceptable.

 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 3 of 8
	TECHNICAL SPECIFICATION FOR MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION	Rev. No. : 0

4.3 Duration of Magnetization

The following values shall be used for magnetization and deposition periods.

Magnetization and particle deposition : 10 Seconds

Re-magnetization : 10 Seconds minimum

Depending upon power concentration examination position and shape of the work piece, durations from the above values may be necessary. The time actually needed shall therefore be determined for each area to be examined.

4.4 Demagnetization

Demagnetization of components, if necessary, shall be carried out by using decreasing alternating current field. The value of magnetic field after demagnetization shall be less than 3 Gauss.

4.5 Examination Medium

4.5.1 Wet Particles

The liquid medium in which magnetic particles are suspended shall be suitably treated, depending upon further process of work piece (e.g. oil can cause porosity during subsequent welding). While using water, rust preventive, antifreeze additives etc., shall be added. Periodical checking up of bath strength should be done as per ASTM-E-138.

4.5.2 Dry Particles

Dry particles method is permitted. Care shall be taken to ensure that powder is adequately dry. An applicator shall be used for rapid and uniform application of the dry powder. Care shall be taken to dust on the powder very lightly and sparingly. A low velocity low pressure air-stream from a hand bulb or a small air-hose may be used to remove excess powder.

4.5.3 Contrast

The powder shall be of a color that will provide adequate contrast with the background of the surface being inspected. The contrast can be improved by

 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 4 of 8
	TECHNICAL SPECIFICATION FOR MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION	Rev. No. : 0

applying a thin coat of fast drying white varnish. (Such varnish coat, results in more precise flaw detection due to the smooth surface). Such varnish shall not have halogen and sulfur content more than 25 ppm each. Varnish coat shall be removed after the test. If fluorescent particles are used, the examination is to be conducted in a darkened area, using filtered “Black light”, with an intensity reading at least 1000 LUX at the work.

4.6 Prod Contact Points

The prod contact points shall be marked, dressed and checked by Dye penetrant. Care shall be taken to keep the prod contact points as few as possible. The current shall be switched on only after proper contact has been established.

4.7 Field Monitoring

Field intensity direction and powder suspension shall be controlled periodically during the test by using Bertholds test plate or field indicator as per ASME Section V.

4.8 Recording of Indications

Recording of indications as permanent records if required (as per referencing document) shall be done on transparent adhesive tapes. These indications shall be transferred on to a paper and preserved with proper identification.

5.0 LIQUID PENETRANT EXAMINATION

5.1 General

In principle, liquid penetrant is applied to the surface to be examined and allowed to enter in-to the discontinuities. Excess penetrant removed, the part dried and a developer applied. The developer functions both as a blotter to absorb penetrant that has been trapped in discontinuities and as a contrasting back-ground to enhance the visibility of penetrant indications.

Either a colour contrast or fluorescent penetrant method may be used. Any one of the following penetrants shall be used.

 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 5 of 8
	TECHNICAL SPECIFICATION FOR MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION	Rev. No. : 0

- Solvent removable
- Post Emulsifying
- Water washable

For nickel base alloys and/or for stainless steel materials the penetrant materials, cleaner, penetrant, developer, etc., used shall not contain Sulphur or Halogen above 25 PPM.

Only NPC approved penetrant materials to be used for testing. Latest list of approved brand of NDT material to be obtained from QA Directorate, NPCIL.

Selection of liquid penetrant material shall be from the same family (brand). Inter-mixing of family of liquid penetrant materials is not permitted.

5.2 Test Procedure

5.2.1 Application of Penetrant

Penetrant shall be applied by means of brushing or spraying. In case, compressed air type apparatus is used for spraying the penetrant, filters shall be placed on the upstream side near the air inlet to preclude contamination of the penetrant by oil, water or dirt sediments that may have collected in the lines.

The entire test surface (including at least 25 mm from either side of area to be examined) shall be covered by the penetrant.

5.2.2 Penetration Time & Temperature

Duration of penetration and test temperature shall be in accordance with ASTM-E-165. Sufficient penetrant shall be applied during the period of test to prevent drying of penetrant upon the surface.

 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 6 of 8
	TECHNICAL SPECIFICATION FOR MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION	Rev. No. : 0

5.2.3 Removal of Excess Penetrant

After the penetration time specified in the procedure has elapsed, any penetrant remaining on the surface shall be removed, taking care to minimize removal of penetrant from discontinuities.

When chemical solvent is being used as the cleaner, care should be taken to ensure that the penetrant is not removed from the flaws.

When the cleaner is water, the pressure of the jet should be kept low (not exceeding 3.5 Kg/cm² and temperature below 43°C).

5.2.4 Application of Developer

The developer shall be applied with spray nozzle of a Spray Gun. The developer shall be sprayed on the entire test surface in such a way that a uniform thin layer is deposited.

5.2.5 Examination and Interpretation of test results

When using the liquid penetrant inspection, the interpretation shall be restricted to, citing the presence or absence of flaws, their general nature magnitude and location. Evaluation of raw material and weld seams shall be performed after the following durations.

- First time after drying of developer.
- After half hour
- After 1 hour

All results shall be recorded and evaluated.

6.0 LIGHTING CONDITIONS

- When conducting an examination under white lighting conditions, the inspector shall ensure that the level of lighting is adequate at the surface of the part (recommended minimum 100 foot candles or 1000 lux).

 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 7 of 8
	TECHNICAL SPECIFICATION FOR MAGNETIC PARTICLE AND LIQUID PENETRANT EXAMINATION	Rev. No. : 0

6.2 Examinations under ultra violet lighting should have a background white light level of less than 20 lux and an ultra violet intensity at the test surface of not less than 1000 μ W/cm².

6.3 The inspector shall allow at least 5 minutes for dark adaptation before beginning the inspection.

6.4 If the examiner wears glasses or lenses, they shall not be photosensitive.

7.0 ACCEPTANCE STANDARDS

7.1 All indications shall be evaluated in terms of the acceptance standards of the referencing "EXAMINATION AND TESTING SPECIFICATION".

7.2 Broad areas of pigmentation which could mask indications of discontinuities are unacceptable and the areas should be cleaned and re-examined.

8.0 PROCEDURE QUALIFICATION

Detailed procedure shall be prepared by supplier for these surface examinations separately and shall be submitted to purchaser approval. Before application of the procedure, the supplier shall demonstrate that the procedure strictly conforms to the stipulations laid down in the preceding paragraphs and meets all requirements of referencing codes and standards of the product.

9.0 PERSONNEL QUALIFICATION

Personnel performing non-destructive examination and evaluation shall be trained, qualified and certified to Level II or Level – III as per recommended practice IS-13805/ISO-9712-3/SNT-TC-1A or any other recognized practice.

10.0 POST CLEANING

Surfaces examined shall be cleaned after evaluation of the test with dry cotton cloth with or without using solvent/cleaner.

 एनपीसीआईएल NPCIL	NUCLEAR POWER CORPORATION OF INDIA LTD	
	ATOMIC POWER PROJECT	Page No. : 8 of 8
	<u>TECHNICAL SPECIFICATION FOR</u> <u>MAGNETIC PARTICLE AND</u> <u>LIQUID PENETRANT EXAMINATION</u>	Rev. No. : 0

11.0 REPORT

Record for each examination shall be prepared in a format, containing all details including the details of the technique adopted and analysis of the results and shall be submitted to purchaser.