

GUIDELINES FOR SELECTION OF NDE AND HEAT TREATMENT AGENCIES AT SITE

(to be deployed by BHEL's E&C Associates)



Bharat Heavy Electricals Limited

Power Sector Eastern Region

Kolkata - 700091

Doc. No. : PP-QLY-AA-DC-106/01-20

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Prepared By Committee	Smarak Kumar Sahoo / Dy Engr. (Member)	On behalf of the committee
	Sontosh Pal / Addl. Engineer Gr.II (Co-opted)	
	Subhradip Joarder / Engineer (Co-opted)	
	Saurav Srivastava / Dy. Manager (Member)	
	Tathagata Dutta / Dy. Manager (Member)	
	Rajesh Das / Dy. Manager (Member)	
	Arup Ratan Paul / Engineer (Convener)	
	Mridul Taisum / Sr. Manager (Chairman of the committee)	
Approved By	Head/ QLY & BE	

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STATUS OF REVISIONS

<u>SL. NO.</u>	<u>REFERENCE OF SHEETS REVISED</u>	<u>REVISION NO. & DATE</u>	<u>REMARKS</u>
01	All	0, Dtd.: 14/09/20	New guidelines developed. Valuable comments / guidelines from CQ&BE and QA-Trichy incorporated in the document.



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1.0 Object

Object of the guidelines is to enable BHEL engineers to make informed decision regarding selection/acceptance of NDE & Heat Treatment agencies; those are deployed by BHEL's E&C associates at site and to evaluate the performance of the agencies.

2.0 General Guidelines

- A. BHEL's E&C associates have to take prior permission/approval before deployment of NDE & Heat Treatment agencies at site. All relevant documents along with the filled-up format as per Annex-A & Annex-B to be submitted by BHEL's E&C associates.
- B. The personnel, proposed by the agency for NDE, should have sufficient experience in testing of welds/castings/forgings/plates and should be capable to interpret the given procedure and carry out the test. Trained, experienced and certified personnel qualified as Level I / II / III (as required) as per SNT-TC-1A of ASNT or BSEN 473 of EN through ASNT / ISNT / CSWIP or its Accredited Agencies should only be deployed.
- C. The personnel, proposed by the agency for Heat Treatment job, should have sufficient experience in heat treatment of welds/castings/forgings/plates and should be capable to interpret the given procedure and carry out the test.
- D. On receipt of proposal along with all necessary supporting documents from E&C associates at site, concerned BHEL Erection engineer & BHEL FQA engineer shall jointly review the proposal and record the details of the accepted agencies as per Annex-C and share with the Construction manager and Head/ Quality & BE/ BHEL-PSER HQ.
- E. The FQA engineer shall also take necessary clearance / acceptance from customer, if required, before acceptance of the proposed agency and maintain a record for that. If customer approval is not required, prior intimation shall be given to the customer through memo.
- F. The NDE / Heat Treatment agency shall meet the requirements of this document plus any additional qualification requirements specified in latest revision of the BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM), as applicable.
- G. Based on the feedback from BHEL FQA engineers, a controlled list (with revision number & date) of accepted NDE & Heat Treatment agencies with their BHEL-approved personnel shall be maintained by PSER-HQ Quality department and this list shall be uploaded in PSER intranet portal.
- H. Monthly performance of the accepted agency/s shall be monitored by BHEL FQA Engineer and the evaluation report to be sent to Head/ Quality & BE/ BHEL-PSER HQ, in MSQR.
- I. The agency may be disqualified/debarred on following grounds:
 - i. if a re-inspection of material or a recheck of NDE / Heat Treatment data shows significant variation from the agency's report, as determined by BHEL FQA engineer
 - ii. if a significant discrepancy or issue (viz. or malpractices like usage of modified/ manipulated Reports/ Charts, other fraudulent activity) is noted during the process audit / routine site inspection..
 - iii. if any of the agency's BHEL-approved personnel has changed without taking prior approval from BHEL FQA In-charge.



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- iv. if the equipment mobilised by the agency no longer meets the requirements for approved usage.
- v. if the Agency is not able to ensure re-qualification of his personnel/ equipment on expiry of certification or is not able to replace such personnel/ equipment in time with permission of the FQA.
- J. The debarred / disqualified agency may apply for re-acceptance only after three months with a written clarification of its previous misconduct and corrective action taken to avoid occurrence of the same incidence. A standing committee of FQA Engineers shall be constituted by Head/Quality & BE/PSER, which shall scrutinise the documents
- K. If, for any of the above reasons, the agency is debarred / disqualified, the same shall be immediately intimated by BHEL FQA engineer to Head/ Quality & BE/ BHEL-PSER Site CM and Main Sub-Contractor with intimation for immediate replacement.. The same shall be updated in controlled list of accepted agencies.
- L. This guideline does not specifically provide any recommendation for safety measures to be taken during NDE & Heat Treatment work. Suitable safety analysis & hazard identification is to be done at site as per the project HSE manual & standard OCP.

3.0 Specific Guidelines for selection of NDE Agency for PAUT (Phase Array UT)

- A. The NDE agency should have executed at least 30% of the proposed work quantity in a single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.
- B. The Agency to submit their organizational setup, supervision arrangement and list of resources to be deployed at site.
- C. For PAUT, the agency shall be capable of mobilising the PAUT equipment & accessories and manpower as follows –
 - i. **PAUT equipment:** Omni scan MX/MX2/X3 or equivalent Phased Array equipment shall be used coupled with Scanner (16:68 or higher configuration), having
 - Weld inspection features including setting up of weld profile.
 - Multi grouping capability.
 - Capability of using two PAUT probes simultaneously. Necessary adapter/splitter (if required) for attaching two probes for simultaneously working should be available for inspection.
 - Operation with battery.
 - A-scan, B-scan, C-scan, S-scan, Linear scan, Sectional scan
 - Calibration: Velocity, Wedge delay, Sensitivity, TCG, DAC, Encoder calibration features.
 - Data analysis and report building
 - Encoder recognition.



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- Probes: At least two numbers of low profile suitable PAUT probes for (MS and Alloy Steel) of 7.5 -10 Mhz frequency, 16-32 element with more than 2 meters of cable length. The probes shall have couplant supply mechanism (passage of couplant) to test surface & required accessories for the same.
- Suitable probes for SS to be made available for inspection of SS joints.
- For Circumferential weld Inspection of Small-Diameter Pipes Advanced semi-automated scanning equipment/ Cobra scanner
- ii. **Wedges:** Specially designed wedges to fit in the above probes and having reference angle of 50 to 60 Degree shear wave in steel will be required. Wedges should have suitable contour to fit around required range of tubes OD (NORMALLY 25 TO 100mm).
- iii. **Scanner:** A manual/automated scanner capable for scanning of required OD (normally 25 mm to 100 mm) tubes. The scanner should have encoder with it for precise data acquisition. The scanner should be able to hold two low profile phased array probes and wedges, as mentioned above for complete inspection of the weld in one rotation of the scanner. The design of scanner, probe & wedges shall allow complete inspection of circumferential weld on tube having gap more than 15 mm with any adjacent tubes, supports and structures etc.
- iv. **Manpower:** The NDE agency shall deploy minimum two persons for performing non-destructive testing. They shall be qualified and certified in accordance with NDE written practice for Training, Examination, and Qualification & Certification of NDE Personnel as PAUT Level-II. The personnel who acquires the data, scan the job, does the calibration and analyse Phased Array data shall be trained on same specific technique and certified as PAUT level II. However, data evaluation and analysis shall be performed by a PAUT Level II or UT Level III. The necessary document/certificate for above to be produced by agency.
- D. **Test Plan / Scan Plan:** The agency shall be capable of submitting the written inspection procedure for PAUT of weld complying with the requirement of latest BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM), duly approved by a UT Level-III person. The procedure / test plan shall be qualified at site as per latest BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM).
- E. **Calibration:** Velocity, wedge delay, sensitivity, TCG, encoder calibration shall be performed by PAUT operator before inspection and as per frequency of code. Verification shall be done by BHEL FQA engineer regarding competency of the personnel deployed by the agencies, prior to start of job.
- F. **Reference block:** Tubes with similar dia & wall thk (within 10% as per code) and circumferential notches/grooves shall be used as reference block. The reference block should have length not less than 200 mm. It should have two circumferential grooves/notches (one each on ID & OD) having depth of 10% of wall thickness. 1 to 1.5 mm width & length between 25 to 50 mm. These two grooves should be located at opposite ends of the tube. The notches should be separated from adjacent tube edge by about 50 mm. These two grooves should be located at opposite ends of the tube. The notches should be separated from adjacent tube edge by about 50 mm. The length of reference block and



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location of reflectors (notches/grooves) should comply the requirement of calibration for angle beams. Agency to take tube samples in advance so that Machine calibration work can be completed before start of work.

- G. **Data Storage:** The calibration data and inspection data should be in the equipment and should be available for verification. Inspection data file to be stored by giving identifiable marking for reporting & interpretation. Agency must be capable to hand over data in suitable media (DVD / Flash Drive).
- H. **Test Result:** The test result submitted by the agency for each tested tube should provide information on type of defects (like lack of penetration, porosity, lack of fusion etc), their location, length, height, depth etc. The final report with above information to be given in an excel sheet along with PAUT inspection data file & images for all the tested joints. Sample copy of test result of previous job to be submitted by the agency.

4.0 Specific Guidelines for selection of NDE Agency for RT (Radiography Test)

- A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (*viz.* copy of Work Order, End User Performance Certificate, *etc.*) for above to be produced by agency.
- B. Agency will submit their organizational setup, supervision arrangement and list of radiography sources to be deployed at site.
- C. Agency to submit the documents of BARC / AERB Level- I & II personnel for doing RT & Interpretation of films, respectively. Personnel's skill & capability will be reviewed by FQA before engaging them in job.
- D. The agency shall comply with all safety norms as per BARC/AERB & agency must submit source movement authorization for the subject site from BARC/AERB before start of work. The source movement within the site shall also be maintained by the agency in the log book. The agency shall fulfil all the safety precautions as per statutory requirements including Radiological safety at their own cost.

E. Manpower & Resources:

- i. For a single unit, The agency shall deploy one BARC/AERB certified site in-charge and minimum of two numbers of BARC/AERB qualified Level-I radiographers for deployment of each number of source and one number of Trained, experienced and BARC/AERB qualified RT Level-II film interpreter. Personnel's skill & capability will be reviewed by FQA before engaging them in job.
- ii. Agency shall mobilize one full time Radiation Safety Officer (RSO) and one site in-charge at site and maintained as per BARC and BHEL OCP guidelines.
- iii. For a single unit, the NDE agency shall have permission from BARC/AERB for mobilizing a minimum of two radioactive sources (as per contractual guidelines) of sufficient strength all the time (minimum of 10 Curie). The source should be replaced immediately after decay to 10 Curie. Agency shall be capable to arrange additional source on emergency.



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- iv. The Agency has to submit the decay chart and all records regarding movement of the source.
 - v. The agency should be responsible for security of their source in the plant or during movement of camera at site.
 - vi. All employees of the agency to use TLD badges & pocket dosimeters while doing radiography testing at site. Also submit annual dose report of radiation workers.
 - vii. The agency to calculate cordon-off distance & provide 'Radiography warning sign boards & symbols' with cordon-off rope & warning alarm while carrying out the radiography.
 - viii. Radiography team to be available at site round the clock
 - ix. Equipment, Film and other consumables used shall be BHEL approved brands.
- F. Agency has to demonstrate and establish various parameters for the quality of radiograph (e.g. Image density, sensitivity, source size, source to film distance, geometric unsharpness etc.,) to the satisfaction of BHEL.

5.0 Specific Guidelines for selection of NDE Agency for UT & MPI

- A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.
- B. Agency will submit their organizational setup, supervision arrangement and list of resources to be deployed at site.
- C. For a single unit, the NDE agency shall deploy a minimum of two number Digital type Pulse Echo A Scan UT equipment (preferably of OLYMPUS, EINSTEIN-II & Krautkramer) along with required calibration block at site.
- D. For a single unit, the NDE agency shall deploy a minimum of two numbers of Trained, experienced and certified Level-I UT technicians and one number of Trained, experienced and certified Level-II Interpreter in UT.
- E. For a single unit in MPI work, the NDE agency shall deploy a minimum of two sets of magnetic yokes, pie indicators, iron oxide particles, colour contrast, etc. Should have portable AC/HWAC equipment delivering current of minimum of 1000 amps and portable AC/DC electromagnetic yokes. Calibrated Equipment/ Ammeters shall be used for testing. The equipment should be capable of testing with visual and fluorescent magnetic particles.
- F. The agency shall deploy a minimum of two numbers of Trained, experienced and certified Level-I technician in MPI and one number of Trained, experienced and certified Level-II Interpreter in MPI.

6.0 Specific Guidelines for selection of Heat Treatment Agency

- A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.



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- B. Agency will submit their organizational setup, supervision arrangement and list of resources to be deployed at site. This must correspond to the requirement mentioned in Sl. No. F
- C. The T & P's for Resistance Heating being deployed by Heat Treatment agency at site viz. PID Control Heating panels, Thermocouples, heating elements, Recorders shall be of renowned make/ branded having provision for digital display (e.g. temperature, Amp/ Voltage etc.), calibrated and in good working condition. Also to be noted that insulation being used should be in workable condition.
- D. The T & P's for Induction Heating being deployed by Heat Treatment agency at site viz. Induction Heating equipment, induction cables, Thermocouples, auto-recorders shall be of renowned make/ branded having provision for digital display (e.g. temperature, Amp/ Voltage etc.), calibrated and in good working condition. The Induction heating equipment should be inverter type (IGBT H Bridge) and output frequency should be 7.5-10 KHz. Also, to be noted that insulation being used should be in workable condition.
- E. Guidelines of BHEL Heat Treatment manuals shall also be referred.
- F. The agency shall be capable of mobilising required number of machines and against each machine one experienced operator & one technician-cum-electrician must be deployed. One experienced supervision staff must be engaged by the agency exclusively for HT job. Qualification of the supervision staff shall be minimum Diploma in Mechanical/ Metallurgical engineering. The competency of operator & condition of equipment must be verified at site, as elaborated in Sl. No. H.
- G. The agency should have capability of mobilising flexible ceramic pads as & when advised by BHEL.
- H. One trial Heat Treatment must be conducted by BHEL engineers before acceptance of the HT equipment and the manpower, to assess the competency of the deployed persons and the condition of the machinery. The thickness & material to be selected based on the maximum thickness & material to be heat treated at site. All results to be recorded by BHEL engineer for future reference. The following are to be monitored and assessed -
- 1) For resistance heating process:
 - i. Equipment's condition and calibration documents
 - ii. Competency of the operator to follow SR job card instruction/ WPS instruction
 - iii. Competency of the operator for selection of Resistance coil gauge
 - iv. Wrapping skill of the operator for single tube/pipe
 - v. Wrapping skill of the operator for bunching of tubes
 - vi. Insulating skill of the operator
 - vii. Competency of the operator for Thermocouple fixing skill
 - viii. Competency of the operator for Programming of PID controller
 - ix. Competency of the operator for selection of ROH/ROC
 - x. Performance after completion of PWHT
 - 2) For Induction heating process:
 - i. Equipment's condition and calibration documents
 - ii. Competency of the operator to follow SR job card instruction/ WPS instruction
 - iii. Competency of the operator for Induction coil/ annealing cable rotation



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- iv. Wrapping skill of the operator for single tube/pipe
- v. Insulating skill of the operator
- vi. Competency of the operator for Thermocouple fixing skill
- vii. Competency of the operator for programming in auto controller of IHE
- viii. Competency of the operator for selection of ROH/ROC
- ix. Performance after completion of PWHT
- x. Competency of the operator to download PWHT graph from auto controller recorder

One mock power failure shall be staged during the trial process to verify readiness of the agency & BHEL's E&C associate for contingency. Acceptability shall depend on the hardness achieved (as measured by UCI machine)

7.0 Revision of this Guidelines

- A. Revision in this Guideline, as may be felt from time to time, shall be decided by the standing committee of FQA Engineers constituted by Head/Quality & BE/BHEL-PSER.

Annex-A**Application for approval of NDE / Heat Treatment Agency at***(Name of Project)*

Name of the NDE / Heat Treatment Agency :

Address :

Name of the Proprietor :

PAN / TIN of agency :

Contact No. :

Email address :

1. Details of Qualified / Certified NDT Personnel (ASNT / ISNT)
(Including BARC certified Radio grapher-RT-1, Site In-charge-RT-2, RSO)

Sl. No.	Name	NDT Method	Level	Date of first Certification	Certificate Valid upto	Certifying Authority

2. Details of Heat Treatment Personnel

Sl. No.	Name	Qualification	Previous Experience

3. Details of NDE / HT Equipment proposed to be mobilised

Sl. No.	Equipment (Make/Model)	Type (RT/ UT/ MPI/ PAUT/ HT)	Quantity	Specification / Rating	Calibration Status	Capacity of the Equipment

4. Details of Previous work done (in past 3 years):

Sl. No.	Project Name & Customer	Type of Job (RT/ UT/ MPI/ PAUT/ HT)	Number Tube Joints completed	Number of Pipe Joints Completed

.....
 Signature of the Owner of the Agency & seal

.....
 Signature of BHEL's E&C Associate & seal

Note : Applicant shall submit supporting documents along with this application and fill the Annex-B

Check list for Annex-A

Note : Applicant shall fill the following details and no column shall be left blank		
Sl. No.	Description	
A.	Name of the Proposed Agency	
B.	Quantum of job being proposed for the agency	
C.	Copy of agencies Govt. Registration	Page no.
D.	Duly filled in Annex-A	Page no.
E.	Certificates for Individuals as mentioned in Sl. No. 1 of Annex-A (Not applicable for HT agency)	Page no. from to
F.	AERB approval certificate (for RT agency Only)	Page no. from to
G.	Supporting documents for previous work Experience as mentioned in Sl. No. 2 of Annex-A	Page no. from to
H.	Supporting documents for previous work Experience as mentioned in Sl. No. 3 of Annex-A	Page no. from to

.....

Signature of BHEL's E&C Associate & seal

Annex-C

Agencies Authorised for conducting NDE / Heat Treatment at

(Name of Project)

Date :

Proposed By (Name of BHEL E&C Associate) :

SL. No	Name & Address of Agency	Type of Job (RT/ UT/ MPI/ PAUT/ HT)	Name of the Persons	Method	Level	Certificate Valid upto	Contact Person, Contact number

Tick (v) applicable

1. Credentials of the above agencies have been reviewed as per Guideline and found acceptable.
2. Trial Heat Treatment has been performed by the HT agency and found to be satisfactory
3. The agencies' personnel have been interviewed and found to possess knowledge of the process & equipment

.....
(BHEL Erection Engineer).....
(BHEL FQA Engineer)**Distribution:**

1. Construction Manager / BHEL Site
2. Head / Quality & BE, BHEL-PSER