

THE APPLICATION OF NDE IN CONSTRUCTION EXAMINATION AND OPERATION MAINTENANCE EXAMINATION OF STEEL MILL

Pi-Kuan Chen

*China Steel Corporation 1 Chung Kang
Road, Hsiao Kang, Kaohsiung 81233
Taibei, China*

Phone:886(7)8021111ext.6215,

Fax:886(7)8022432

E-mail: 043281@mail.csc.com.tw

ABSTRACT

The integrated steel manufacturing processes are composed of raw material preparation, iron making, steelmaking, and rolling. During the process several plants are included such as the chemical plant, power plant, oxygen plant, water treatment plant...etc

The NDE of China Steel Corporation executes the construction examination of the project, which is linked together to the production equipment in-service examination. The main factors for successful apply NDE are : Involvement the examination in the right time, display the function of examination, guarantees carries out quality of examination, feedback information to project management and so on.

During the construction examination, achieves the effect includes: 1.Good project quality 2. Guarantee the equipment operate smoothly and enhance the production efficiency 3. Reducing the equipment service cost.

The production period equipment in-service examination, achieves the effect includes: 1. Knew in advance maintenance 2. Traces and control the service progress 3. Analyze the reason of damages 5. Operate equipment smoothly.

Base this, must guarantee the carry out quality of NDE for achieves the effect of the construction examination of the project and the production equipment in-service maintenance examination is important, this article shows its procedure: 1.The establishment system is divided the responsibility management. 2. Truly carries out method 3.To prevent abuses the examination.

Keywords: Nondestructive Examination , Construction Examination , In-service maintenance Examination

1. INTRODUCTION

From the beginning of construction to the end of producing the product, the NDE is applied in the steel mill. The reason for NDE depends on the component and its effect on plant operation. Pressure vessels, pipes, tubes, and tanks are examine to avoid forced outages. Examination of crane girder, steel structure, is done for safety and operational reasons. Involvement the examination in the right time, display the function of examination, guarantee the carryout quality of examination, feedback the information for construction management are keys to the successful applied NDE.

2. EXAMINATION OPPORTUNITY

The suitable examination opportunity involvement examination may obtain the good interaction, avoids unsatisfied production with delaying and affects the project progress. The examination opportunity divides into:

2.1 Under Construction :

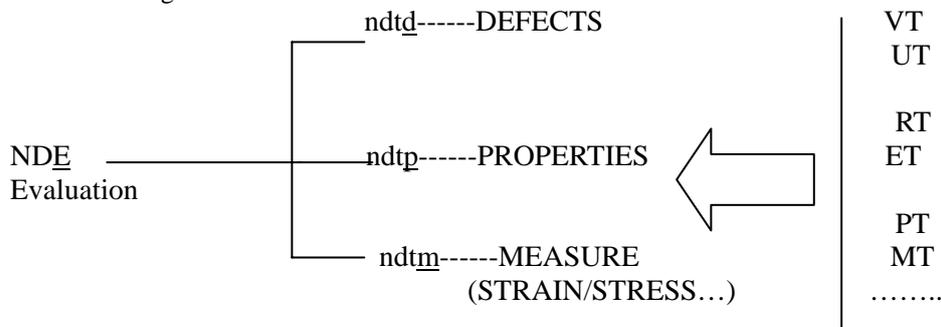
- a. For decision manufacture method
- b. For decision manufacture condition
- c. For quality control
 - i). Prior manufacture ii). During manufacture iii). Post manufacture
- d. For manufacture

2.2 In-service:

- a. To check before acceptance
- b. To check during shut down

3. FUNCTION OF NDE

The functions of NDE include the flaw detection of outward appearance size to the internal crack detection, the material characterization measurement and establishment the database of materials behavior that is correspondence to the chemical or physic property. And so on enters the non-destructive evaluation. It's relational following table:



4. HOW GUARANTEES THE NDE QUALITY

Once the production equipment in-line is commissioned, it is not practical to take off-line to service or very difficult for design additions or modifications. But truly carries out the examination using NDE, can be prohibitive the revenue losses due to the non-predictive shut down. For example, in construction the piping, we apply five NDE methods to examine pipe, for guarantees the quality and will avoid the loss when operating in the future. Its method as follows:

4.1 Visual Testing- VT

The welding process is visually inspected to ensure compliance with a qualified welding procedure specification (WPS) developed for the configuration and welding parameters being welded (typically, a fillet weld of the shielded metal arc low hydrogen variety). Past experience reveals that visual inspection of the essential variables in the WPS produces about a 95% confidence level in the weld's suitability for service.

4.2 Magnetic Particle Testing- MT

The completed weld is magnetic particle tested by dry particles in order to detect any discontinuities that are open to the surface or subsurface. This is a "go/no-go" step in order to qualify the weld for radiographic testing. It should be noted that the weldment is dry tested in order to accommodate further testing with minimal cleaning.

4.3 Ultrasonic Testing- UT

The pipe is ultrasonically tested using a longitudinal wave to verify sufficient wall thickness and that lamination is not present. After that then using transverse wave do the weldment flaw detection.

4.4 Radiographic Testing- RT

Once the weld passes the requirements of magnetic particle testing, it is radiographically tested using a single source (IR-192) double wall technique, Its process divides into:

- a. For fillet or branch connection welds, because of the geometry of the weldment, the radiographic image produced by this technique does not allow for accurately quantifying discontinuities. Therefore, it does not meet the regulatory requirements (API-1104, Section 6). However, it does provide the data necessary for

assessing the disposition of the weld by detecting discontinuities that could provide an initiation point for cold cracking, due to entrained hydrogen.

- b. For butt-joint welds, the radiographic images do provide the necessary information for evaluating the critical nondestructive testing document for this weld.
- c. Because cold cracking is a time driven phenomena, a follow-up radiographic test is performed once a minimum of 48 hours has elapsed since completion of the weld. This test is performed for the sole purpose of identifying any cracks that may have initiated from a discontinuity or a localized stress point.

4.5 Liquid Penetrant Testing-PT or MT

For fillet or branch connection welds, the radiographic images produced for this weld configuration are not code acceptable. However, the images do provide the necessary information for evaluating the critical elements of the weld. Therefore, a final PT or MT is required as the official NDE document for this weld. This test is conducted using a fluorescent medium because it is the most accurate for our application and its residue does not impair any additional testing or maintenance activities, at this point.

5. THE EFFECT OF NDE

To take NDE as the tool for obtained information uses in the project management and the production process gain effect includes:

5.1 During the construction examination, achieves the effect includes: 1.The project quality is good 2. Will guarantee the equipment to operate smoothly and enhance the production efficiency 3. Will decrease the equipment service cost.

5.2 The production period equipment in-service examination, achieves the effect includes: 1. Knew in advance maintenance 2. Traces and control the service progress 3. Analyze the reason of damages 5. The equipment operation is smooth.

5.3 Feedback the information for construction and production management, achieve the effect includes: 1). the progress, the quality, the controls of main flaw 2). Know the quality of manufactures and the improvement direction 3). Do the management of welder by the NDE acceptable rate.

6. NDE PROCEDURE

Base this, must guarantee NDE to carry out the quality for achieves the effect of the construction examination of the project and the production equipment in-service maintenance examination is important, its procedure:

6.1 The establishment system is divided the responsibility management.

Draws up the NDE execute rules, in order to help correlation unit divided the responsibility management.

6.2 Truly carry out method.

a. Qualification for Welding Performance

The entire welder should pass qualification test and possess a valid certificate in order to participate in the welding jobs. The welders' valid certificates, the detailed test descriptions as well as the related welding regulations should be submitted before the work actually starts.

b. Inspection of Welding

i). Subcontractor shall perform the self-inspection in his work site area. The inspection methods (VT, RT, UT, MT or PT), NDE positions in the fabricated parts and CSC must also approve NDE quantities. The NDE positions and NDE standards shall be marked on drawings prepared by contractor and sent to CSC for approval.

ii). CSC may perform NDE for all the fabricated parts, and the NDE ratio for each lot will be no less than 10%.

iii). CSC must inspect all the defect parts discovered through NDE again at contractor's expense.

c. Inspection of the Products

i). The self-inspections can be classified into three categories visual inspection (structure form, welding and painting), NDE inspection (RT, UT, MT or PT) and dimensional inspection.

ii). All the self-inspection reports, which are performed by subcontractor, should also be examined and signed page-by-page by the local representative of contractor.

iii). The self-inspection project can be assigned to some other notarized NDE inspection company. However, all the inspectors who perform this NDE inspection must have certificate checked and approved by CSC before the contract is actually executed.

6.3 Prevents abuses the examination.

i). The name list of welders shall be issued to CSC before starts to work and updated monthly.

ii). The statistics for welders' leave or absence shall be submitted to CSC monthly.

- iii). The welder's pass number should be marked beside the welds of the fabricated parts, such as structures, piping, vessels and equipments.
- iv). The WPS (welding procedure specification) and work schedule shall be submitted to CSC before the contract is actually executed.
- v). In order to control the welding quality, when the welder's NDE inspection point reach fifty (RT, UT, MT or PT), the welder's performance will be checked and counted. If the defect ratio is higher than 15%, CSC shall have the right to cancel this welder's pass and treat this welder as " disqualified ".

CONCLUSIONS

The truly NDE execution will guarantee the equipment to operate smoothly and enhance the production efficiency. As previously stated, visual inspection can yield a confidence level of approximately 95%, when properly applied. Only 5% approximately flaws need to check by other NDE methods.

The range of NDE includes quality inspection and processing measuring. The items of quality inspection are 1). detection of surface / internal defect 2). measuring dimension 3).measuring the parameter of processing factors. The purpose of processing measuring is to get the information quickly for feedback to reach and monitor the optimum processing control for product quality.

Under the dual request of product output and quality, the time of machinery maintenance has been limited; therefore the machinery reliability, availability, maintenance, and safety will grow important day by day. The technology of steel processing industry has trended from waste energy、 air pollution to computer-based、 optical-electric、 energy improvement and hi-tec related business.

Automatic Nondestructive Testing and Measuring devices are extremely valuable for using in quality improvement and competition promotion.