Development of the Aging Management Program for HVAC Systems

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1. Introduction

The HVAC(heating, ventilation and air conditioning) systems in nuclear power plants are consisted of fan, damper, duct, filter and cooling coil, which is equipped in the safety-related building such as main control room, auxiliary building and containment building. These systems are designed to maintain the required ambient air temperature in all plant areas for the comfort and safety of personnel and for environmental requirement of equipment and to ensure that the gaseous radioactivity emission to the environment is kept below permissible discharge limits. The purpose of this study is to establish the inspection plan to ensure that touch-up parts of the duct are sound and to develop the aging management program for maintaining effectively HVAC systems.

2. Methods and Results

2.1 Aging Evaluation

The aging evaluation method is identifying physical condition of the equipment to verify whether aging effects can be managed adequately or not for maintaining the safety margin and identifying the aging management program for safe operation. Components that did not include PSR or need to be periodically managed have been selected in accordance with NUREG-1801(GALL). Selected components are duct, support, duct access door, access door seal, damper seal, flexible collar, housing, mounting frame and etc. Based on NUREG-1801, aging effects with selected components made by carbon steel will be loss of material caused by corrosion and cracks due to fatigue, in case of non metallic components aging effects will be leak by hardening and wear. Comprehensive evaluations for aging effects have been performed by walk-down to acquire information in relation to current physical condition of selected systems and components. Figure 1 shows a flow chart for aging evaluation of HVAC components.

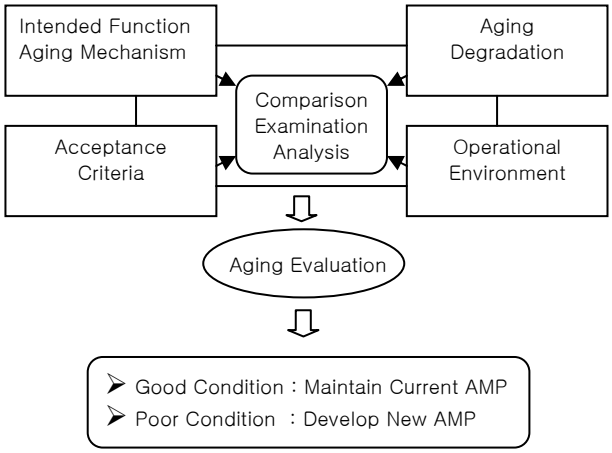

Figure 1. Flow Chart for Aging Evaluation of HVAC

2.2 Examination Plan for Duct Touch-up Part

To establish the examination plan of the duct touch-up part, KEPIC MID Code was used as a reference. Duct body and attachment welded directly to body within the 2D range should be inspected for integrity. Examination must be conducted completely at 100% within 10 years. Non destructive examination should be conducted to detect discontinuous or defective weld through VT-1. In case flaw indications should be found, MT or PT for surface inspection must be conducted. Table 1 shows the inspection program, table 2 shows examination categories and table 3 shows acceptance criteria for flaws.

Table 1. Inspection Program for Duct Touch-up Part

Long Inspection Period	Short Inspection Period	Minimum Examinations Completed(%)	Maxmum Examinations Completed(%)
ALL	3 years	16	50
	7 years	50	75
	10 years	100	100

Table 2. Examination Categories

Item No.	Parts Examined	Examination Method	Extend of Examination
K1.10	Touch-up (Weld)	VT-1 Surface/Leak test	Within 1 inch from Weld
K1.20	Duct Exterior Surface	VT-1	Within 2D from Weld
K1.30	Welded Attachment	VT-1	100%

Table 3. Allowable Flaws

Component thickness (t, in)	Lamina Area (A, in^2)	Surface Flaw (l/t, %)	Subsurface Flaw (l/t, %)
Below 2.5	7.5	17.4	28.6

2.3 Development of the Aging Management Program

The aging management program for HVAC systems makes it possible to manage systematically history of aging and degradation on components. Especially how to link each components of a system could be verified visually by 3D viewer equipped with this system. Figure 2 shows the program layout and Figure 3 shows main screen of 3D viewer.

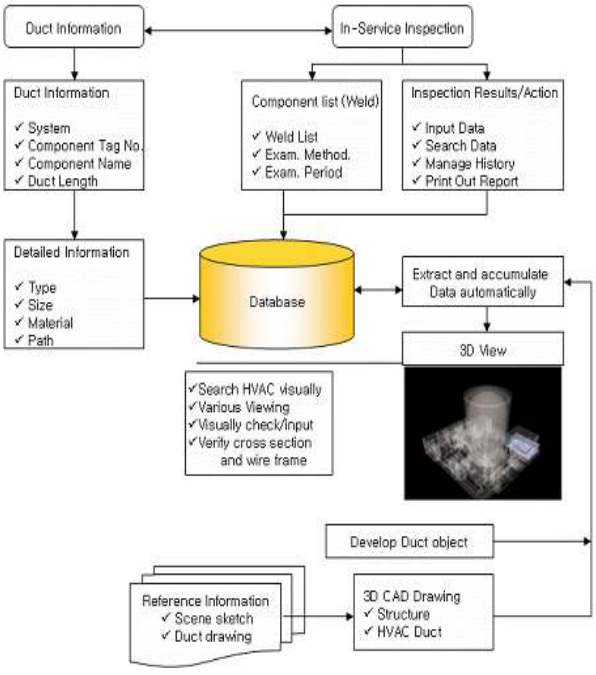

Figure 2. Lay-out of the Aging Management Program

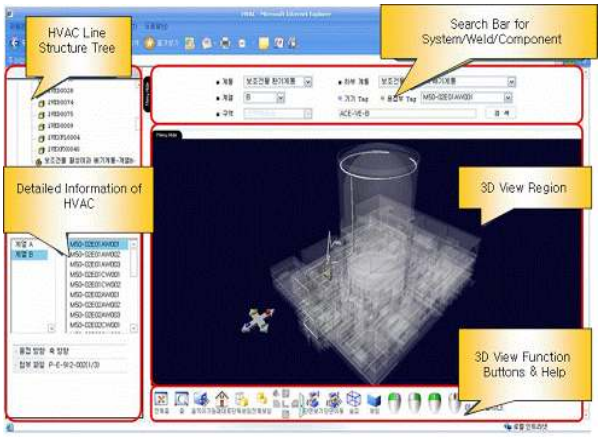

Figure 3. 3D Viewer of HVAC System

3. Conclusion

Through this study as follow up steps of PSR, the inspection plan of touch-up parts of duct weld was established to ensure integrity. The aging management program for HVAC systems was developed to manage aging data effectively.

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