

OPDE

Development of OPDE Piping Failure Database

150

19

가

가 , 가

, PSA , 가

가, RI-ISI(Risk Informed In-service Inspection) ,

가(PSR)/ (LR)/ (AM) 가

. 2002 , OECD/NEA 가

OPDE(OECD Piping Failure Data Exchange) .

OPDE

OPDE ,

가 , PSA

, 가 , RI-ISI , PSR/LR/AM

OPDE .

Abstract

The uncertainty in the evaluation of nuclear piping reliability is relatively high because the failure frequency of nuclear piping is very low compared to the failure of active components. This kind of uncertainty may significantly affect on the evaluation results in some application areas such as failure trend analysis, PSA, ISI, RI-ISI, and PSR/LR/AM. In 2002, Nuclear Energy Agency of the Organization for Economic Co-operation and Development (OECD /NEA) has established the OPDE project to encourage multilateral co-operation in the collection and analysis of data relating to pipe failure events. Korea Atomic Energy Research Institute has joined with Korea Institute of Nuclear Safety in the project to perform data collection and validation efficiently. This paper presents the OPDE project objectives and work scope and proposes some techniques for the data evaluation for some applications including failure trend analysis, PSA, ISI, RI-ISI, and PSR/LR/AM.

1.

가 가 가 가 ,
 , , 가
 가
 가 DB가 ,
 가 가 ,
 가 가
 가 가
 가(PSA), (LBB) (Screening Criteria) 가,
 가(PSR) , 가 (RI-ISI)
 가

OECD/NEA

가

OPDE (OECD Piping Failure Data Exchange)

. 2000 12 OECD/NEA OPDE CSNI
 (Committee for Safety of Nuclear Installations) , 2001 4
 , 2002 5 1 OPDE
 가
 OPDE
 OPDE ,
 가 PSA 가, LBB 가,
 , RI-ISI

2. OPDE

1) OPDE

OPDE 1 2002 5 2005 4 , 3
 3 US\$ 300,000 가
 , , , , , , , 11 .

OPDE DB SKI DB SKI DB
 가 가
 . SKI DB MS-Access 97 1970 2000

public domain SKI DB IAEA AIRS (Advanced Incident Reporting System) DB
 4,000 SKI DB 400 4,400 (water hammer) 6

SKI DB ERIN (Engineering and Research, Inc.)
 ODPE DB (Clearinghouse) ERIN

2) OPDE

OPDE [1].

(feedback) Insight (defenses) 가

가

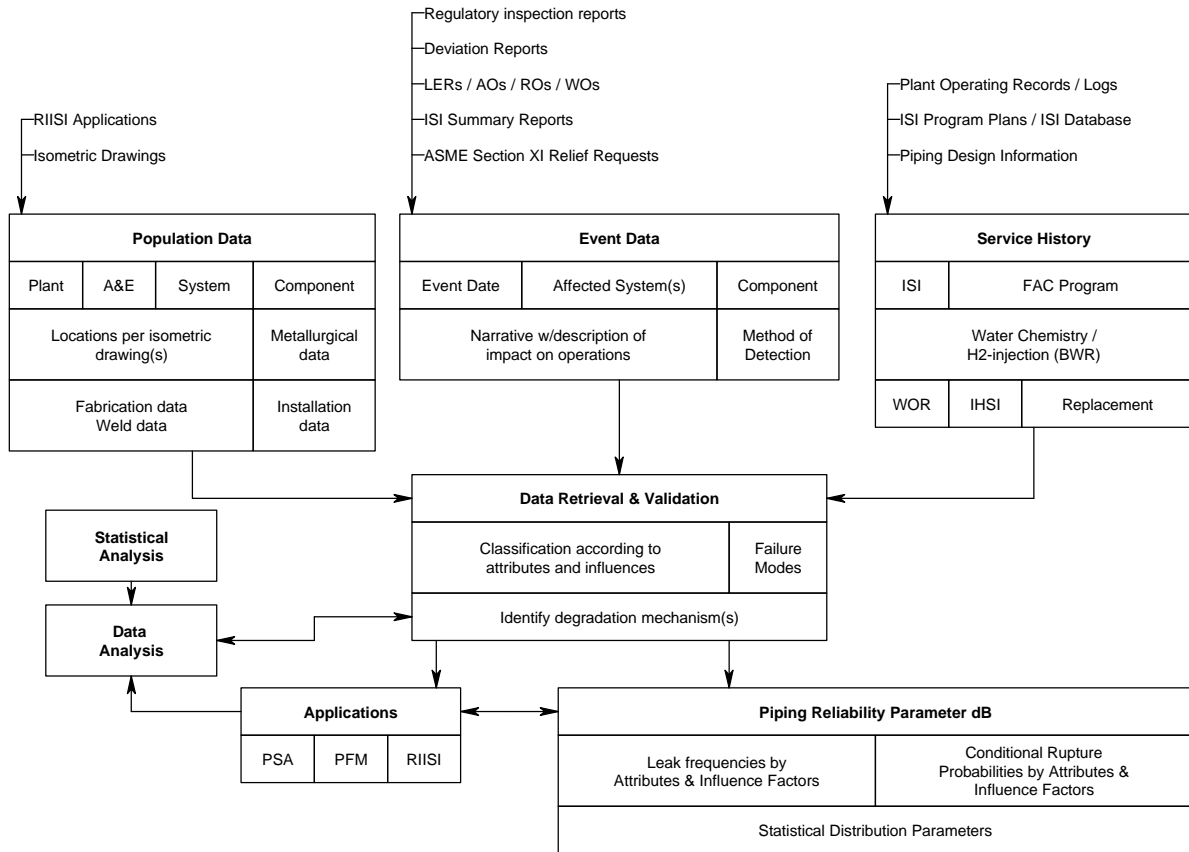
가

3) OPDE DB

OPDE DB 1 Population Data, Event Data, Service History
 Data 3
 [2].

- ✓ : , , NSSS , ,
- ✓ : , , , , ,
- ✓ : , , , ,

- ✓ 가 : 가 (In-service Inspection, ISI), ISI
- ✓ : / , , , , , ,
- ✓ : , / ,



1. OPDE DB

OPDE DB가 (, , ,)
 HAZ) , , , , .
 (Class 1, 2, 3) (Common Cause Failure, CCF)

OPDE DB

- ✓
- ✓ Code
- ✓ ISI (Recordable Indication)
- ✓ (Small Leak : Pin Hole or Drop)

- ✓ Tech. Spec.
- ✓ 50gpm (rupture)
- ✓ Water Hammer

4) 1

가 2002 5 1 . 2002 5 20 2003 5 15 1

1

✓ 가 OPDE DB SKI DB DBMS (OPDE Rev. 0)
OPDE DB (level)

✓ SKI DB 가 가

(: 6).

✓ 가 OPDE DB 가 .

1 , OPDE ,

1999 2001 OPDE

, 1

3.

OPDE 가 OPDE .

OPDE 가 (National Coordinator) [3].

DB , 1,2 DB framework ,

DB 가 [3].

OPDE OPDE

1 OPDE

1)

OPDE

, OPDE DB

Plant Population Data

Isometric

, FSAR

가

Event Data

, TR (Trouble

Report), CNF (Customer Notification Form)

, Service Data

ISI

가

1

✓

(type)

✓

✓

(level)

2) OPDE

OPDE

✓

✓ PSA

✓ 가

가

✓ RI-ISI(Risk Informed In-service Inspection)

✓ PSR(Periodic Safety Review)/ /

PSA

PSA

가가

가

가

Plant Population Data가

Plant Population Data (Pipe Failure Frequency), P (1) 가 가 j

$$P = \frac{N_{j,event}}{\sum_{i=1,n} N_{i,j} \times Y_i} \quad (1)$$

n , Y_i i 가 . N_{i,j} i 가 j () , N_{j,event} 가 j (event)

(event tree) (fault tree) (initiating event) (basic event) , 가 , 가

가 OPDE 가 ASME Code Sec. XI ASME Code Sec. XI , 가 , 가 , OPDE , 가 , 가 (Generic Problem) (Specific Problem) 가

RI-ISI RI-ISI 가 , 가 RI-ISI 가 , f(X) (2)~(5) (normal distribution), (log-normal distribution), (exponential distribution), (Weibull distribution) [4].

$$f(X) = \frac{1}{\sqrt{2\pi} \sigma} \exp\left\{-\frac{1}{2} \left(\frac{X - \mu}{\sigma}\right)^2\right\} \quad (2)$$

$$f(X) = \frac{1}{Xs\sqrt{2p}} \exp\left\{-\frac{1}{2}\left(\frac{\log X - m}{s}\right)^2\right\} \quad (3)$$

$$f(X) = \frac{1}{m} e^{-X/m} \quad (4)$$

$$f(X) = \frac{a}{b} \left(\frac{X}{b}\right)^{a-1} \exp\left\{-\left(\frac{X}{b}\right)^a\right\} \quad (5)$$

m $b\Gamma(1+1/a)$, s $b^2(\Gamma(1+2/a) - \{\Gamma(1+1/a)\}^2)$.
 OPDE (Recordable Indication) 가

$\frac{PSR/}{가}$ / $가$ $가$

, PSR 가 $가(PSR)$ $가$,
 PSA $가$ PSA insight (importance Measure) $가$
 PSA $가$ $가$ OPDE PSA insight PSA
 insight

4.

OPDE

OPDE

OECD/NEA

OPDE

, 2002

가

가

11

5

1

가

, DB

SKI DB

가

OPDE

Insight

(defenses)

(feedback)

가 ,

OPDE

OPDE

OPDE

가

, PSA

, 가

가, RI-ISI

, PSR/ /

OPDE

가

OPDE

(

10,000\$)

OPDE

SKI DB 4,400

OPDE

,

[1] OECD/NEA . “OECD Piping Failure Data Exchange (OPDE) Project Terms and Conditions for Prohect Operation”, January 21, 2002.

[2] OPDE Clearinghouse . “OPDE Database Coding Guideline & Quality Control Manual”, OPDE-PR01, July, 2002.

[3] , . “OPDE ”, KAERI-KINS 3, September, 2002.

[4] Miller, I., Freund, J.E., Johnson, R.A., 1990, “Probability and statistics for engineers,” 4th edition, Prentice-Hall Press.