Development Status of Periodic Verification Program for Safety-Related Motor-Operated Valves

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Introduction

☐ Status of regulatory recommendation for MOV

	U.S	Korea
To evaluate operability	1989: GL89-10 (U.S NRC)	1997: Recommendation (MOST)
To evaluate operability periodically	1996: GL96-05 (U.S NRC)	To be issued
	JOG PV program	KHNP & KEPRI

JOG : Joint Owners' Group
KHNP : Korea Hydro & Nuclear Power Company
MOST : Ministry of Science & Technology

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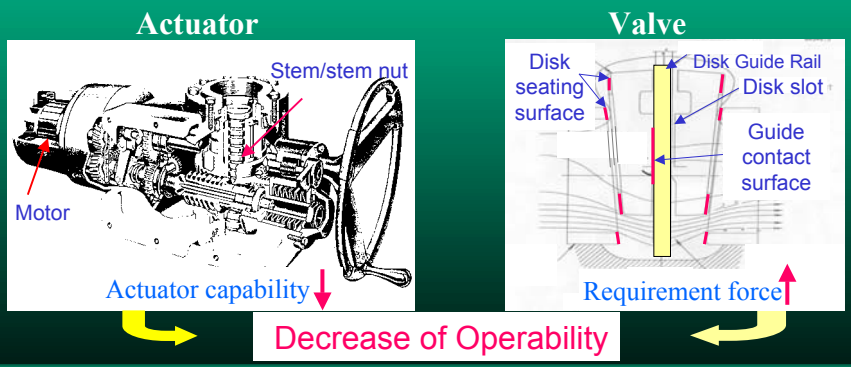
Introduction (Cont'd)

☐ Necessity of PV

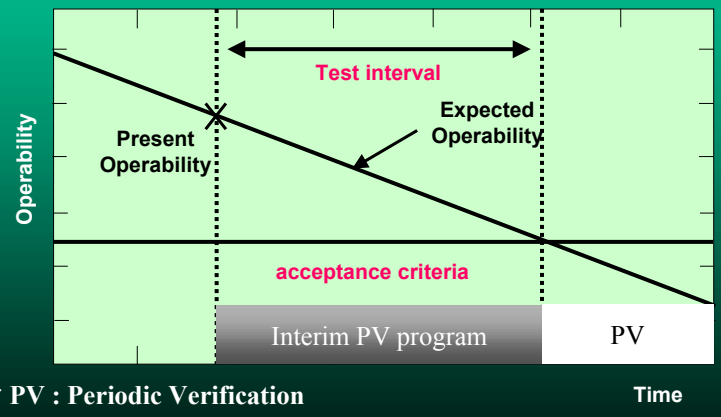
❍ Continuous degradations with time

☐ Degradation Mechanism



Introduction (Cont'd)

☐ Relationship between degradation and operability



* PV : Periodic Verification

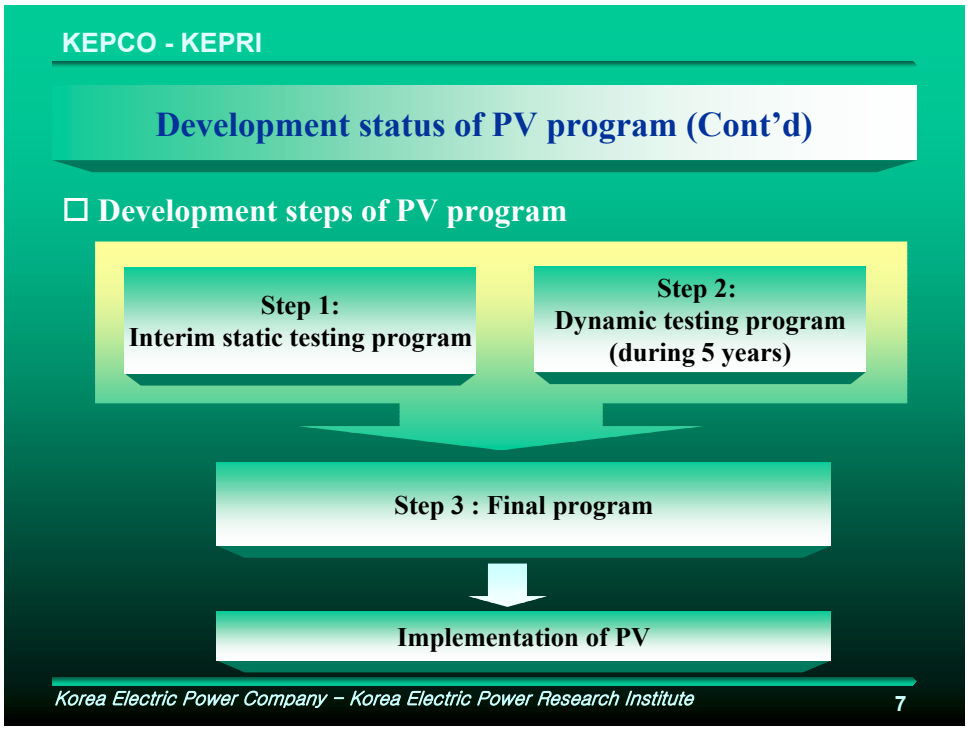
Development status of PV program

☐ Final objective of PV program

Static test → - Available to all MOVs
- Good for observation of actuator degradation

Dynamic test → - Impractical to some MOVs
- Good for observation of actuator & valve degradations

For test practicability,
Static test is selected as PV method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Development status of PV program (Cont'd)
☐ Development steps of PV program
Step 1:
Interim static testing program
Step 2:
Dynamic testing program
(during 5 years)
Step 3 : Final program
Implementation of PV
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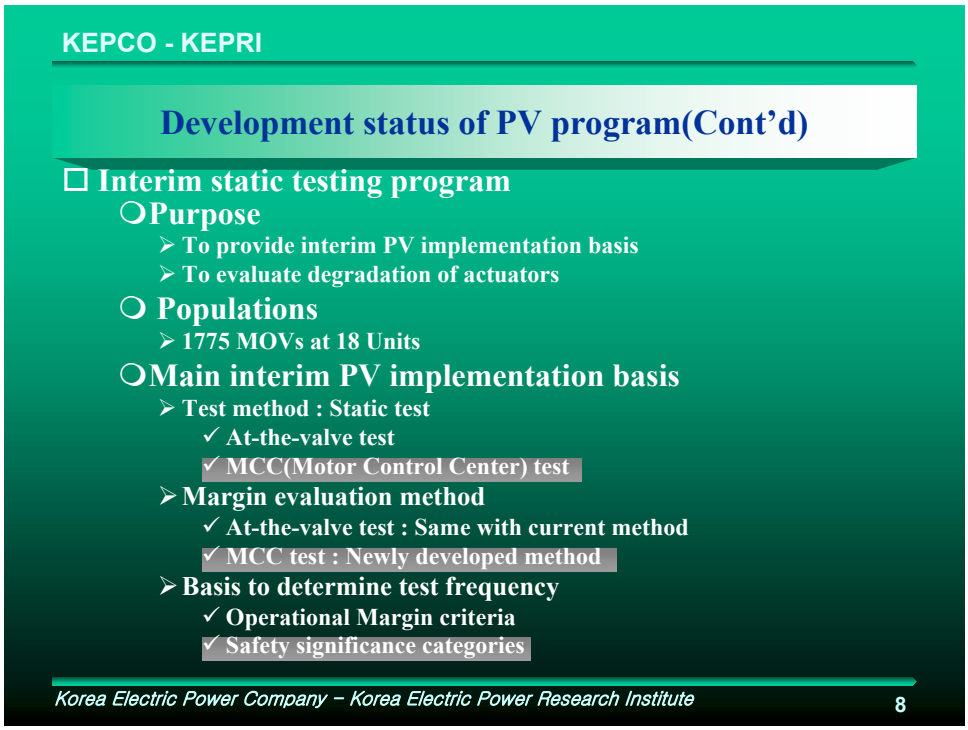
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Development status of PV program(Cont'd)
☐ Interim static testing program
❍Purpose
➢ To provide interim PV implementation basis
➢ To evaluate degradation of actuators
❍ Populations
➢ 1775 MOVs at 18 Units
❍Main interim PV implementation basis
➢ Test method : Static test
✓ At-the-valve test
✓ MCC(Motor Control Center) test
➢ Margin evaluation method
✓ At-the-valve test : Same with current method
✓ MCC test : Newly developed method
➢ Basis to determine test frequency
✓ Operational Margin criteria
✓ Safety significance categories
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Development status of PV program(Cont'd)

☐ Interim static testing program(Cont'd)

❍ Test frequency

Safety Significance category*	Static test frequency(refueling cycle)			
	At-the-valve test			MCC test
	Operational Margin Low(>5%)	Operational Margin Medium(5~10%)	Operational Margin High(>=10%)	Operational Margin High(>=25%)
High	1	2	3	2
Medium	2	3	3	3
Low	3	3	3	3

* Categorization of safety significance by PSA(Probabilistic Safety Assessment), etc.

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Development status of PV program(Cont'd)

☐ Interim static testing program

❍ Procedures

- ➢ Periodic verification implementation(PV-01, Rev. 0)
  - ✓ Diagnostic method based on MCC and At-the Valve test results
  - ✓ Operational margin determination method for each stroke and test
  - ✓ Stem lubricant injection steps
  - ✓ Determination method of test frequency
  - ✓ As-found condition monitoring methods
- ➢ Evaluation of periodic verification results(PV-03, Rev.0)
  - ✓ Evaluation methods of operational margin and test frequency

❍ Computational software development for procedures

- ➢ MOVIDIK is web-based software for MOV performance evaluation developed KEPRI and stands for MOV Integrated Database Information of KHNP & KEPRI

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Development status of PV program(Cont'd)

☐ Dynamic testing program

❍Purpose

$$\text{Margin}(\%) = \frac{\text{Actuator capability} - \text{Force Requirement}}{\text{Force Requirement}} * 100$$

* Valve degradation ➡ Force requirement ↑ ➡ Margin ↓

Prediction of degradation during valve lifetime

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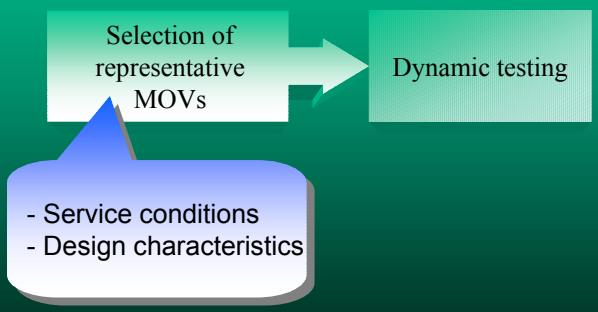
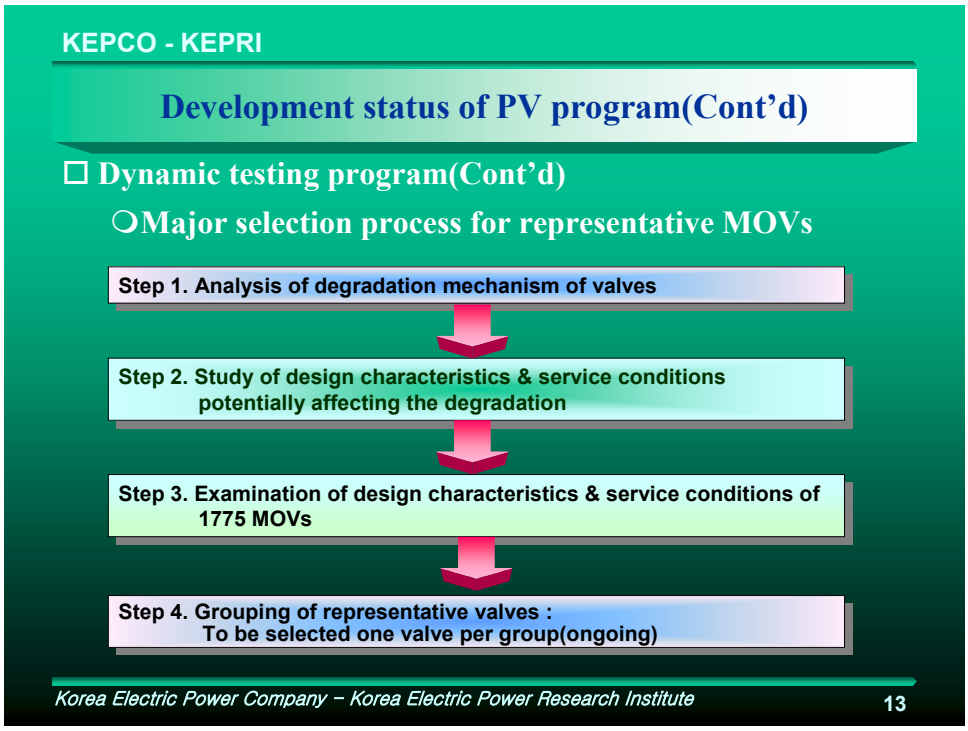
Development status of PV program(Cont'd)

☐ Dynamic testing program(Cont'd)

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Development status of PV program(Cont'd)
☐ Dynamic testing program(Cont'd)
❍Major selection process for representative MOVs
Step 1. Analysis of degradation mechanism of valves
Step 2. Study of design characteristics & service conditions potentially affecting the degradation
Step 3. Examination of design characteristics & service conditions of 1775 MOVs
Step 4. Grouping of representative valves : To be selected one valve per group(ongoing)
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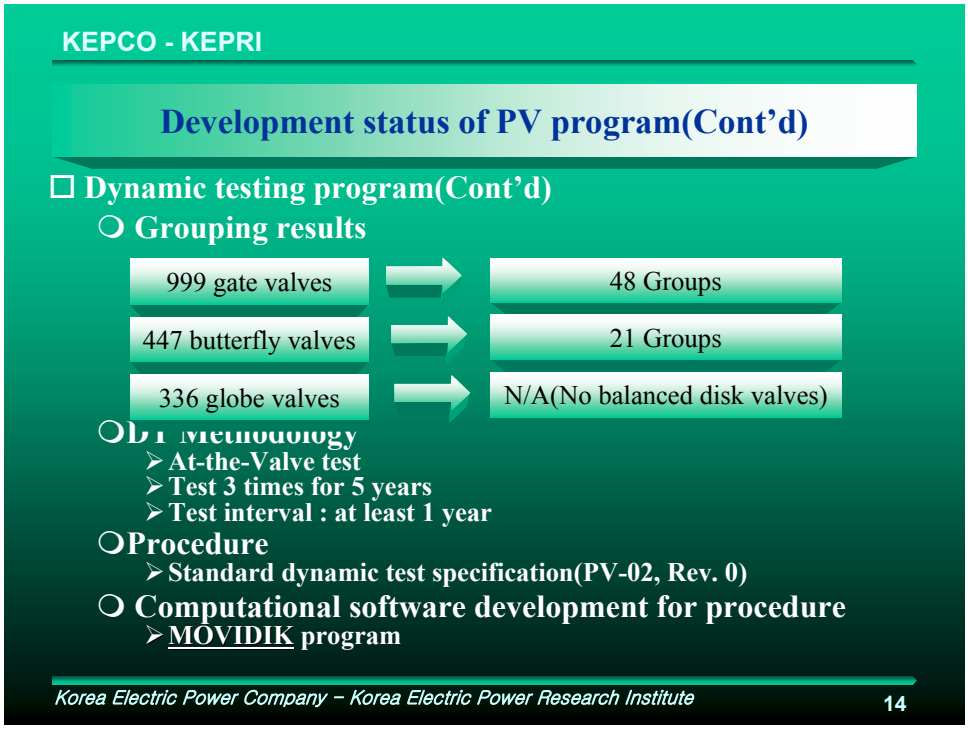
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Development status of PV program(Cont'd)
☐ Dynamic testing program(Cont'd)
❍ Grouping results
999 gate valves
48 Groups
447 butterfly valves
21 Groups
336 globe valves
N/A(No balanced disk valves)
➢ At-the-Valve test
➢ Test 3 times for 5 years
➢ Test interval : at least 1 year
❍Procedure
➢ Standard dynamic test specification(PV-02, Rev. 0)
❍ Computational software development for procedure
➢ MOVIDIK program
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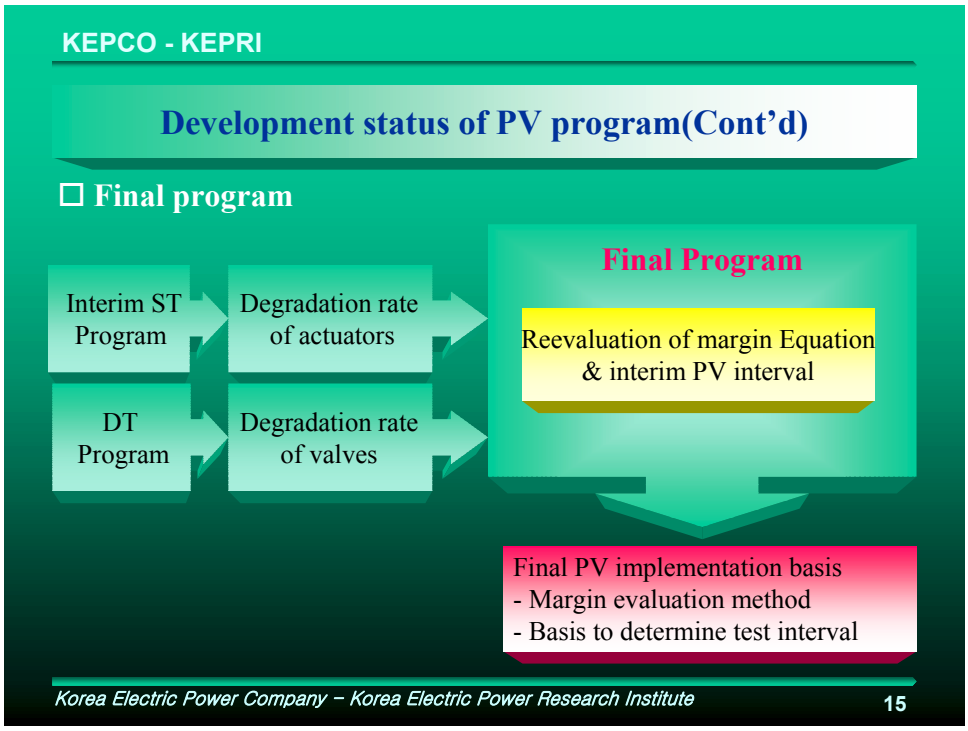
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Development status of PV program(Cont'd)
☐ Final program
Interim ST Program
Degradation rate of actuators
DT Program
Degradation rate of valves
Final Program
Reevaluation of margin Equation & interim PV interval
Final PV implementation basis
- Margin evaluation method
- Basis to determine test interval
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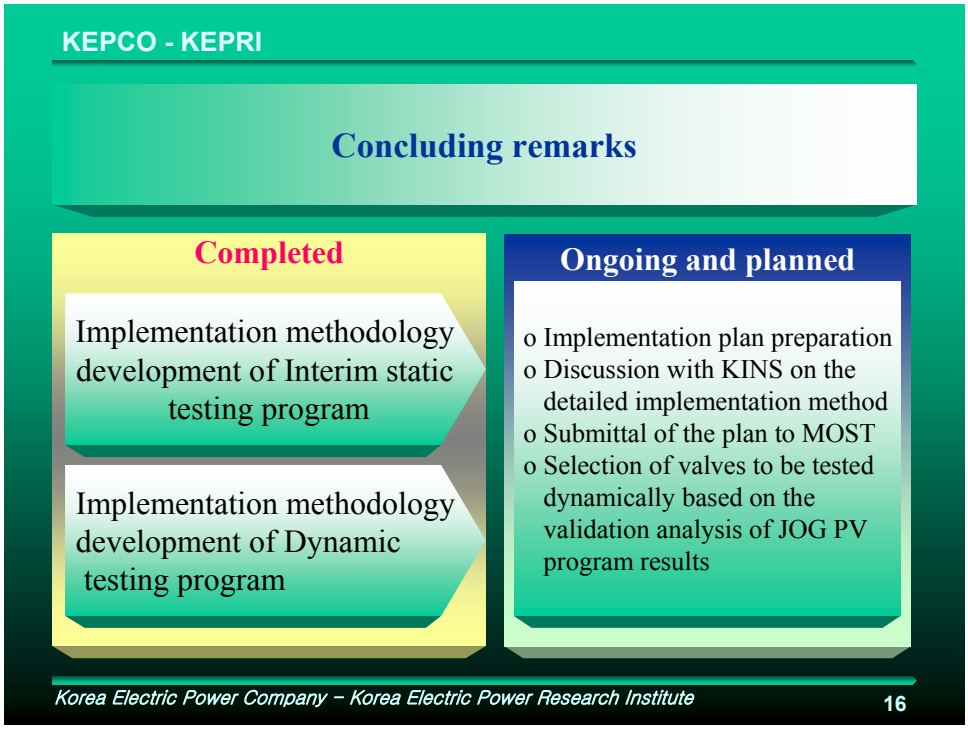
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Concluding remarks
Completed
Implementation methodology development of Interim static testing program
Implementation methodology development of Dynamic testing program
Ongoing and planned
o Implementation plan preparation
o Discussion with KINS on the detailed implementation method
o Submittal of the plan to MOST
o Selection of valves to be tested dynamically based on the validation analysis of JOG PV program results
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