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# Introduction



## ◆ The Status of Korean NPPs

<b>Operating</b>	<b>23 Units</b>	<b>20,716 MW</b>
<b>Constructing</b>	<b>5 Units</b>	<b>6,600 MW</b>
<b>Planning</b>	<b>6 Units</b>	<b>8,400 MW</b>



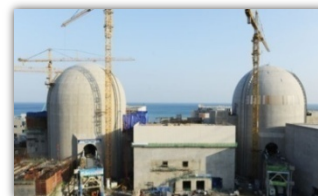
**Hanul 1,2,3,4,5,6**



**Shin-Hanul 1,2**  
**Shin-Hanul 3,4**



**Wolsong 1,2,3,4**  
**(PHWR)**



**Shin-Wolsong 1,2**



**Kori 1,2,3,4**



**Shin-Kori 1,2**  
**Shin-Kori 3,4**  
**Shin-Kori 5,6,7,8**

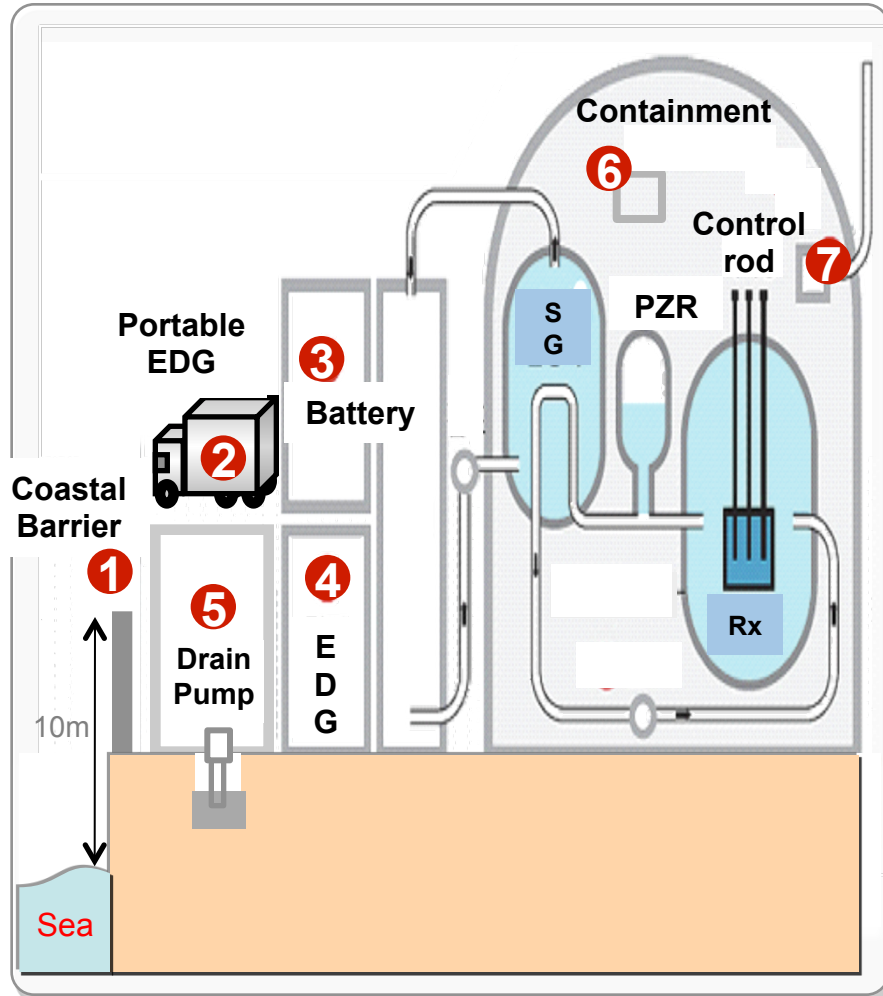


**Hanbit 1,2,3,4,5,6**

# Introduction



## ◆ Major Post-Fukushima Actions



- ① Making the coastal barrier higher at Kori site
- ② Preparing a vehicle with a portable power generator (Gas-Turbine type)
- ③ Securing the safety of emergency battery power from flooding
- ④ Installing watertight doors at EDG buildings
- ⑤ Applying the water-proofing motors for pumps
- ⑥ Installing passive hydrogen removal systems which are operated without electricity [PAR]
- ⑦ Installing a containment filtered venting system [CFVS]

# NSC Concept



## ◆ Nuclear Safety Culture History Worldwide

Country	Events Triggering Safety Culture	Years
Soviet	Chernobyl Accident	1986
USA	Davis-Besse Reactor Header Erosion	2002
Japan	TEPCO Scandal Fukushima Accident	2002,2006 2011
Korea	Unreported Kori-1 SBO	2012
?		

Lesson Learned:

Culture makes NPPs more vulnerable than expected. ♪

# NSC Concept



## ◆ Nuclear Safety Culture History Worldwide

- IAEA published INSAG-4 on SC(safety culture) in 1991.
- Korean Government published nuclear safety policy in 1994.
- INPO and NRC have elaborated SC in US since 2002.
- KHNP introduced a nuclear safety vision in 2003.
- The SC assessment method was developed in 2006 to measure both perception and adherence to SC attributes established by IAEA.
- INPO and NRC published NSC principles and characteristics of a mature stage in 2010.
- The Fukushima Nuclear Accident was occurred in 2011.
- KHNP published SC 6 principles and 26 action statements in 2011.
- **Unreported Kori 1 SBO was revealed in 2012.**
- KHNP conducted Kori SC assessment in 2012.
- KHNP revised SC 6 principles and 24 action statements in 2012.
- NRC revised SC Policy Statement in 2012.

# NSC concept development in Korea



## ● What is nuclear safety culture?

- NSC is one of important concepts of culture in nuclear industry because nuclear plants have unique risks, such as core damage, intense energy density and so on.

## ● What is difference between NSC and industrial safety?

- NSC is to prevent public from harms of radioactive material, but industrial safety is to prevent workers from injuries.

## ● Are there any entities to reflect NSC?

- NSC consists of assumptions, belief and artifacts. The artifacts involve Corrective Action Program, Work-order process, design change process, etc. The artifacts could show the level of NSC, but not NSC itself. Therefore, there is neither visible nor tangible entity of NSC. NSC is like a shadow.

## ● If there is no entity of NSC, how can NSC be improved?

- Everybody can **sing**. There are singers who **sing very well**.
- Everybody can **operate** a valve. There are workers who **operate a valve safely**.
- Therefore, NSC is an **adverb** to reinforce a **verb**.

# NSC concept development in Korea

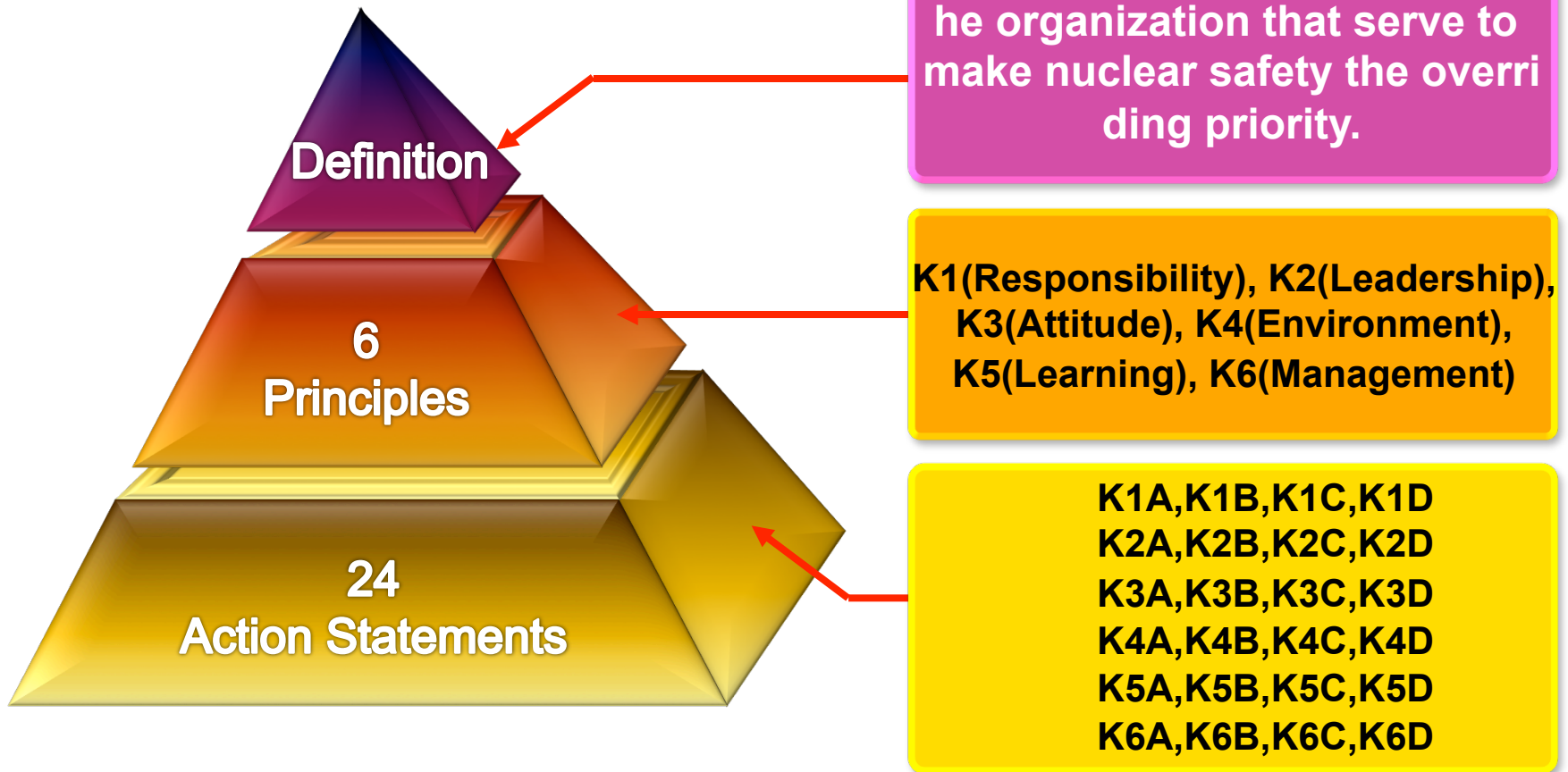


- **If NSC is an adverb rather than a verb, how can NSC be treated as an important element?**
  - You know that Psy the singer has earned lots of money.
  - What discriminates nuclear power plants is adverb rather than verb.
- **If NSC is very important to NPPs, Should NSC be written in every procedures?**
  - No. Even though some statements in procedures are written with caution notes, causes cannot be inserted in every statements because of reading burden.
  - Instead, every workers should have proper attitudes of NSC in mind rather in procedures
- **How to foster NSC in heart?**
  - To build NSC principles and action statements
  - To adopt NEI-09-07 (Fostering NSC)

# Korean NSC Framework



## ◆ The NSC Model of KHNP





# Korean NSC Framework



## ◆ KHNP NSC 6 Principles

### **K1. [Responsibility]**

**Everybody is responsible for nuclear safety.**

### **K2. [Leadership]**

**Leaders demonstrate personal commitment to nuclear safety.**

### **K3. [Attitude]**

**Personnel always has a questioning attitude at work.**

### **K4. [Environment]**

**Safety conscious work environment is established.**

### **K5. [Learning]**

**Learning and improvement activities are continued.**

### **K6. [Management]**

**Nuclear safety fostering systems are implemented.**

# Korean NSC Framework



## ◆ NSC Elements

NSC Definition



NSC Principle



NSC Action Statements



- **KHNP NSC principles and action statements have been developed considering Korean culture with referential safety culture principles from IAEA, NRC, and others.**
- **Action statements are not less important than principles.**
- **The principles and action statements have been developed for easy-understanding of NSC by excluding abstract expressions and simplifying complex sentences.**
- **The term ‘action statements’, instead of ‘attributes’, emphasizes practice and utilization.**

# Korean NSC Framework



## ◆ NSC 6 Principles and 24 action statements

- **K1. Everybody is responsible for safety (Responsibility).**
  - **K1a, Nuclear safety is the first priority of all work activities.**
  - **K1b, Roles and responsibilities for nuclear safety are clearly understood.**
  - **K1c, Nuclear safety related regulations and procedures are observed.**
  - **K1d, Personnel demonstrate ownership for nuclear safety in day to day activities.**
- **K2. Leaders demonstrate commitment to safety (Leadership).**
  - **K2a, Leadership and professionalism of nuclear safety are demonstrated.**
  - **K2b, Vertical/horizontal communication is encouraged.**
  - **K2c, Leaders actively and willingly participate in nuclear safety related activities.**
  - **K2d, Nuclear safety related issues are managed, and conflicts are resolved.**

# Korean NSC Framework



- **K3. Personnel always has a questioning attitude at work.**  
**(Attitudes)**
  - **K3a, Unique properties of nuclear technology are fully understood, and given tasks are cautiously performed.**
  - **K3b, Mistakes are perceived, and the worst situations are prepared.**
  - **K3c, Opinions are reviewed and considered to decision making.**
  - **K3d, Questions are raised, and abnormalities are reported immediately.**
- **K4. Safety conscious work environment is established.**  
**(Environment)**
  - **K4a, Trust permeates the organization**
  - **K4b, Personnel can raise nuclear safety concerns without fear of retribution.**
  - **K4c, Nuclear safety related issues are feely raised.**
  - **K4d, Nuclear safety related actions are acknowledged, and incentives are provided accordingly.**

# Korean NSC Framework

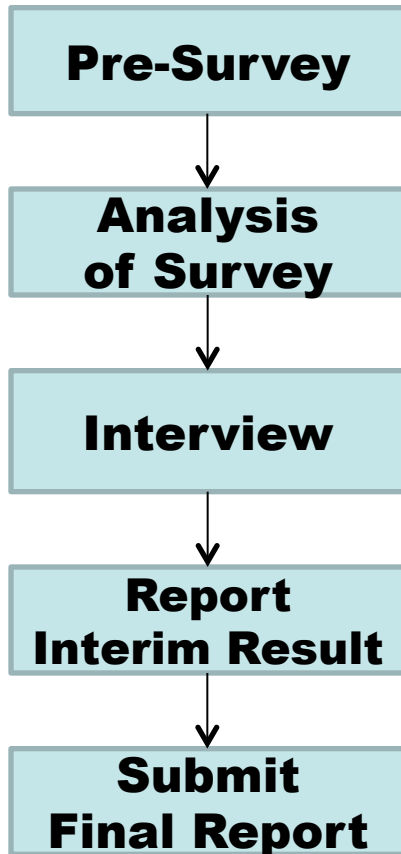


- **K5. Learning and improvement activities are continued.**  
**(Learning)**
  - **K5a, Specialized training and education are periodically given.**
  - **K5b, Nuclear safety related training and education are given according to personnel's level.**
  - **K5c, Operating experiences are timely analyzed and used.**
  - **K5d, Improvement activities are continuously executed.**
- **K6. Nuclear safety culture fostering systems are implemented.**  
**(Management)**
  - **K6a, Nuclear safety policy is set, and its values are shared among members of organization.**
  - **K6b, Nuclear safety is firstly considered to business planning and distribution of human resources.**
  - **K6c, Periodic nuclear safety culture assessments and self assessments are performed.**
  - **K6d, Findings of assessment are reflected in the operation process and procedures.**

# KHNP NSC Assessment



## ◆ NSC assessment process



- **Measuring the level of NSC awareness (based on the principles of NSC in KHNP, K1~K6)**

- Pre-Survey
- Interview

- **NSC index**

$$\frac{(40 \times \text{No. of Negative Response}) + (70 \times \text{No. of Neutral Response}) + (100 \times \text{No. of Positive Response})}{\text{No. of Total Response}}$$

- If interviewee answers are neutral, The value of the index is 70 points.
- In other words, the more the number of positive answers, the higher the value of NSC index.

# KHNP NSC Assessment



## ◆ KHNP NSC Index

Principles <sup>1)</sup>	I=1, 2 ... 6	<p>NSC Index<sup>3)</sup></p> $S_{IJ} = \frac{w_1 \times P_{IJ} + w_2 \times B_{IJ} + w_3 \times N_{IJ}}{T}$
Action Statements <sup>2)</sup>	J=a, b, c, d	
Weighting Factors	$w_1=100, w_2=70, w_3=40$	
No. of Positive Responses	$P_{IJ}$	
No. of Blank Responses	$B_{IJ}$	
No. of Negative Responses	$N_{IJ}$	
No. of Total Responses	$T = \sum_{J=a}^d \sum_{I=1}^6 (P_{IJ} + B_{IJ} + N_{IJ})$	

# KHNP NSC Assessment



## ◆ KHNP NSC Index

### Note)

- 1) 1: Responsibility, 2: Leadership, 3: Attitude, 4: Environment, 5: Learning, 6: Management**
- 2) 24 Action statements of the KHNP NSC**
- 3) 70 points of the index means a neutral answer. The index increases with more positive answers. In other words, the index is the same concept of a statistical average, and it represents NSC instead of three variables; positive, neutral and negative. The range of the index is 40 to 100.**



# KHNP NSC Assessment



## ◆ NPP NSC Assessment(2012)

### ● Purposes

- To measure the level of workers' NSC awareness
- To enhance continuously and settle NSC

### ● Assessment period and NPPs

Plants	Pre-Training	Assessment Period	
		Pre-Survey	On-site Assessment
KORI 1,2	5.17	5.14~18	5.21~24
WOLSONG1,2	6. 7	6. 4~ 8	6.12~15
HANBIT1,2	6.28	6.25~29	7. 2~ 5
HANUL1,2	7.12	7. 9~13	7.16~19

# KHNP NSC Assessment



## ● Scope of Assessment

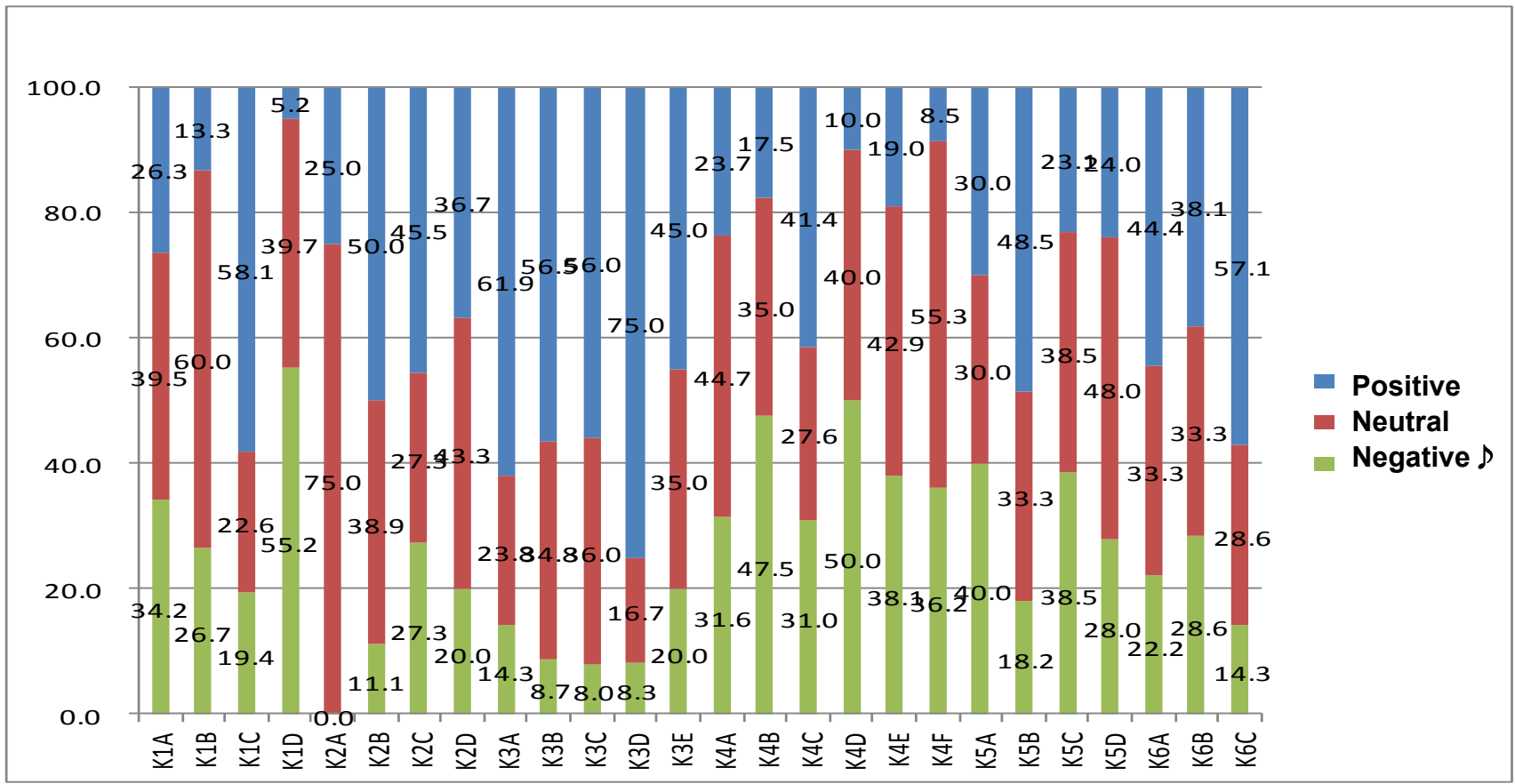
Plants	The number of workers			
	Group	Pre-Survey	Interview	Total
KORI 1,2	KHNP	195	175	336
	Contractors	100	45	190
WOLSONG 1,2	KHNP	276	121	425
	Contractors	272	20	332
HANBIT 1,2	KHNP	220	118	316
	Contractors	140	33	293
HANUL 1,2	KHNP	239	116	338
	Contractors	155	33	271
TOTAL		1,597	661	2,501

※ **Approximately 50% people of total workers participated in Survey.**  
**Approximately 35% people of total workers participated in Interview**

# KHNP NSC Assessment



## ◆ NPPs NSC in a graph with previous action statements



# KHNP NSC Assessment



## ◆ Good Practices in the NPP

- **Contingency plans are well prepared.**
  - **Most workers have sufficient skill and knowledge to cope with contingency.**
  - **Work progresses are shared during senior morning meeting.**
  
- **Lesson learned from the Kori SBO accident is fed back to NSC.**
  - **NSC principles are preferred to illegal commands from seniors.**
  - **Decisions are based on safety rather than production.**
  - **Being aware of their complacency**
  - **Willingness to accept other cultures**

# KHNP NSC Assessment



## ◆ Good Practices in the NPP

### ● Well-established processes and systems

- Periodic procedure revision
- Use of operational experiences
- Supervisor's observation, pre-job briefing, and human error prevention tool were thoroughly performed.

### ● Ownership based on the notion of 'we are the last barrier of NSC' is not compromised despite public blames

- Most workers were willing to mitigate consequences of severe events before reporting accidents.
- Managers had emphasized that the unit 2 should be operated more safely even though the unit 1 couldn't be in operation soon.

# KHNP NSC Assessment



## ◆ Areas of improvement in the NPP

- **Plant characteristics should be considered while allocating resources.**
- **Safety performance index should be developed to motivate workers.**
- **Partnership with contractors should be strengthened.**
  - **Long waiting time to get a job permission and to carry in/out equipment**
  - **Less experienced KHNP workers to supervise contractor's experienced experts**
  - **Short term contracts prevent maintenance companies from hiring skilled experts.**
  - **Small sized contractors can't keep NSC cultivation systems.**

# KHNP NSC Assessment



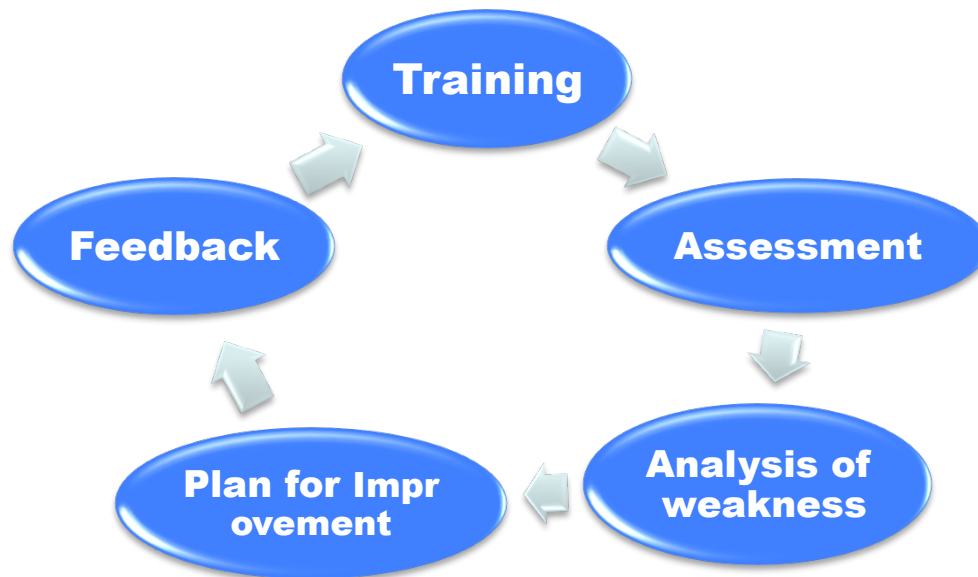
## ◆ Areas for improvement in the NPP

- **Communication should be encouraged.**
  - **Top down communication prevails in organizations. Consideration to understand background of commands and to listen to concerns of workers is needed.**
  - **The stress caused by accident investigation weakens trust between members.**
  - **Workers consider MV(Management Vitality) as a burden than a rest.**
- **NSC should be educated especially for**
  - **Senior managers with high authority**
  - **Expert with complacency**
  - **Workers who are reluctant to change**
  - **Workers who despise general affairs except for their own activities**

# NSC Enhancement Measures

## ◆ KHNP Strategic Objectives for NSC

1. To establish infrastructure to enhance NSC
  2. To create Safety Conscious Work Environment (SCWE)
  3. To intensify safety mind of all employees
- Implemented framework to enhance NSC





# NSC Enhancement Measures

## NSC enhancement infrastructure

- To improve processes to assess NSC
- To apply NSC assessment program periodically
- To set up plant specific NSC promotion programs
- To operate a NSC council between KHNP and Contractors
- To train special NSC training courses to all general managers
  - Reinforcing safety leadership training for all executives
  - Customizing NSC curriculums for new employees and top management

# NSC Enhancement Measures



## Safety conscious work environment

- **Emphasis on policy of NPP operation regarding safety aspect**
  - Internal management evaluation scheme was changed to benefit the organization that contributes to enhancement of safety.
  - Extension of overhaul duration for better preparation and thorough checkups
- **Establishment of Site NSC oversight organization at all sites (for 24hours)**
- **Building employee concerns program(ECP)**
- **Performing a periodic safety video conference**
- **Holding safety culture workshops**

# NSC Enhancement Measures



## Safety mind of employees

- To start a special campaign, “**Safety Culture LOVE+ 365**”
  - **L**aw, **O**bedience, **V**aluable, **E**fforts, all together(+), **3**  
**65** days(everyday, week, month)
  - Pledge, Weekly messages, Safety meeting, Slogans etc.
- To observe and prevent the factors to weaken NSC at all times
  - Develop and utilize the checklist of SC observation in the field
- To cultivate expertise of NSC throughout the organization
- To develop and utilize the education contents of NSC
  - NSC training materials
  - NSC poster and safety message
  - NSC comprehensive manual

# NSC Enhancement Measures



## NSC Posters & Campaign

Love + 365 운동은  
안전문화 활동을 모두가 함께 하이러진 운동이에요!!

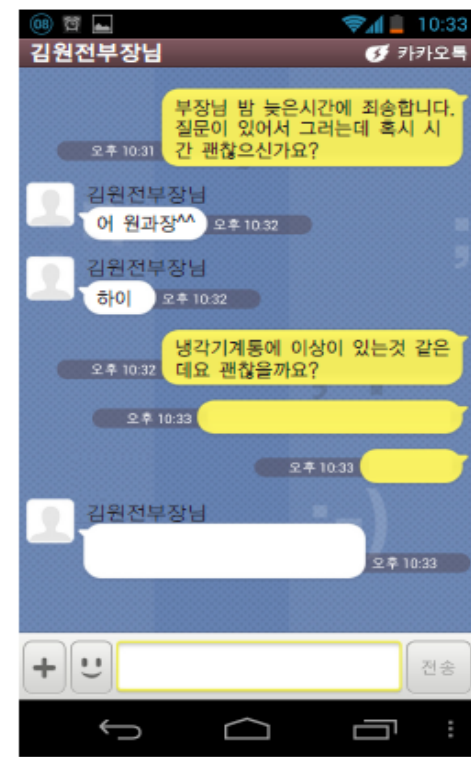
**L** = 원칙(Law)  
**O** = 준수(Obedience)  
**V** = 가치있는(Valueble)  
**e** = 노력(Effort)  
**+** = 참여(+)  
**365** = 1년 365일

**LOVE + 365 의미**  
규정과 원칙(Law)을 준수(Obedience)하는 가치있는(Valueble) 노력(Effort)에 모두가 참여(+)하는 활동으로써, 기 시행중인 안전문화 활동을 일, 주, 월 별로 특성화하여 1년 365일 시행, 효과를 극대화.

세부 활동		
일 [O]	주 [O]	월 [O]
<b>안전구호</b> • 대형화물 후 안전구호 제정 (중대 특성화 또는 개량) 2회 • 안전다짐 • 안전문화사 준수사항 1회 (2회 이상) • 장비점 기동수칙 1회 낭독 (1회 이상)	<b>안전문화 점검</b> • 주요 작업시 안전문화 준수 상태 점검 (15개 안전문화 분야 포함)	<b>안전문화 교육</b> • 동시다점 참여하기 맞춤형 교육 (인간자원-이동자원) • 안전문화 확산 시범 (10시 - 14시 및 14시~)
<b>안전연의(ECP)</b> • 안전 문화 교육 제작 발표 및 강의 (1회 이상)	<b>안전문화 게시지</b> • 안전문화 게시지 제작 및 교육자료 활용	<b>안전 특성화의</b> • 분사, 사업부/과 안전 문화 공유 (중대 안전문화 분야)

의문이 들면 질문하고, 이상상태는 즉시 보고해야 한다.

업무시간이 아니어서 대하기 힘들어서 그냥 넘어가실건가요?



# Conclusions

- **KHNP established a safety culture policy to put safety first. 6 principles and 24 action statements have been developed and are being utilized in the field.**
- **KHNP is developing the various contents to improve safety culture; posters, dynamic contents, web programs , etc.**
- **KHNP has been implementing the NSC assessment to measure the level of workers' NSC awareness since 2006.**
- **Improvement items for NSC were proposed from NSC assessment result. And post actions are being implemented through a short or long term plans in KHNP.**
- **Currently, The NSC of Korea is emphasized than ever before, and is being strengthened step by step from CEO to all employees.**



Thank you