

DNMC's Distinctive Way to Increase Safety During Pre-operational of LNPS-II NPP



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November 14, 2012

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1. Basic Information

- **Daya Bay Nuclear Power Operations and Management Co., Ltd. (DNMC) was established in 2003 through the joint investment of Guangdong Nuclear Power Joint Venture Co., Ltd. (GNPS owner) and Ling Ao Nuclear Power Co., Ltd. (LNPS-I owner). After equity adjustment in September, 2009, CLP Nuclear Power Operation (China) Co. Ltd. and Guangdong Nuclear Power Investment Co. Ltd hold 12.5% and 87.5% equity of DNMC respectively.**
- **Entrusted by the three owners, DNMC is responsible for the operations and management of the six 1000MWe PWR units.**
- **During the pre-operation period of LNPS-II, DNMC is responsible for the operations preparation.**

◇ Mission, Vision and Values

■ Mission

To protect the interests of customers, shareholders, employees and the society. To ensure long-term and safe, environment-friendly, reliable and economical power generation. To further develop core competencies to contribute talents, technology and experience to the sustainable development of CGN.

■ Vision

To become a world-class professional nuclear power operator.

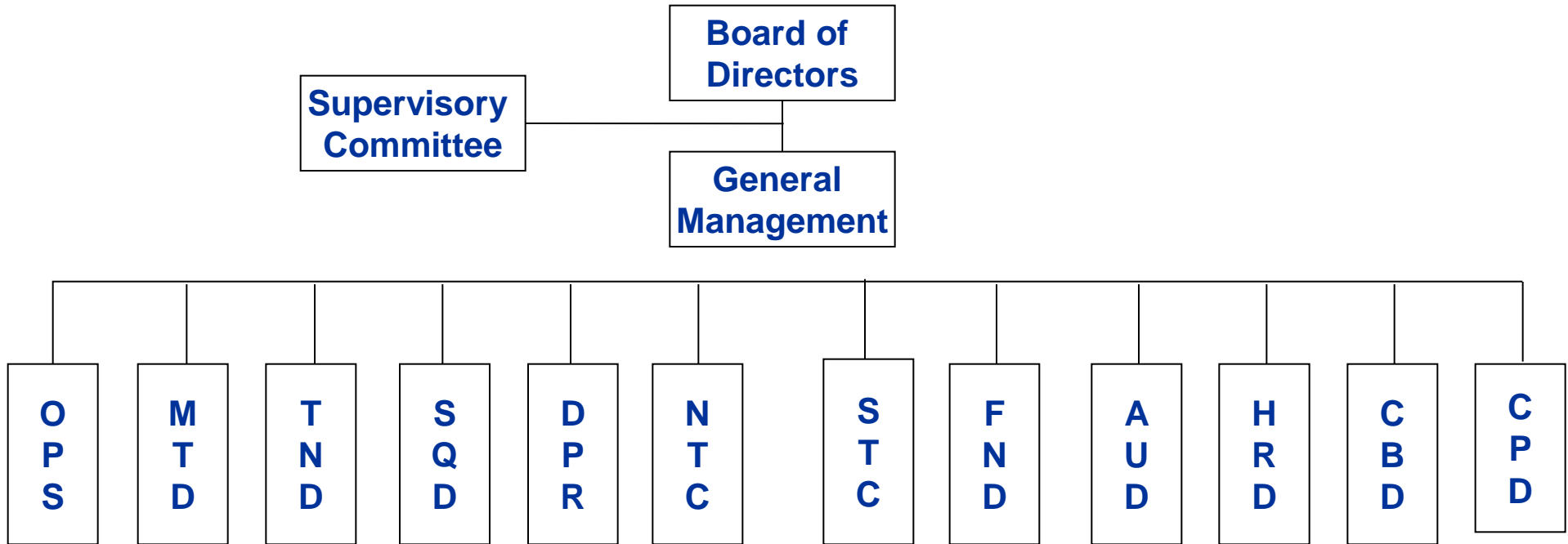
■ Values

Safe Production, Credibility and Transparency, Teamwork, Pursuit of Excellence

◇ Professional Operations Management

- To carry out integrated management principles, standards, requirements and methods to several nuclear power plants in order to optimize resources allocation, achieve scale economies effect and improve safety level and economic returns. As a result, public confidence can be enhanced and core competencies of the industry improved.

◇ Organizational Structure



The departments directly related to operation preparation of LNPS II are DPR, OPS, MTD, TND, SQD and NTC. HRD and other departments of the company provide support for operation preparation within their respective responsibilities.

◆ Geographic location

- Daya Bay nuclear power Base is situated on the coast of Daya Bay to the east of Shenzhen, and 45 and 50 kilometers from downtown Shenzhen and Hong Kong respectively.



◇ GNPS

- **As the first-ever large commercial nuclear power plant in Mainland China, GNPS consists of two Pressurized Water Reactors (PWR) of 984 MWe each. The plant has been constructed and operated under the pattern of “starting at a significant height to introduce, digest, absorb and innovate” and “constructing with loans, repaying loans with revenues from electricity sales and joint venture operations”. The main structural work commenced in August 1987 and GNPS was put into commercial operations on May 6, 1994.**

◇ LNPS-I

- Taking GNPS as its reference model, LNPS-I has two PWRs of 990 MWe each with its 52 significant technical improvements. Its annual generation capacity is about 15 billion KWh, all sent to the Southern Grid.
- The construction of LNPS-I was started on May 15, 1997, and it had been put into commercial operations on January 8, 2003, 66 days ahead of the schedule, saving USD 381 million which equaled 10% of the total budget approved by the State authorities.

◇ LNPS-II

- LNPS-II is the only nuclear power project constructed during the 10th Five-Year-Plan period and is a leading project under the national self-reliance program of the industry. Two CPR1000 units of 1000 MWe series, a brand owned by CGNPG, are planned.
- The main structural work was started on December 15, 2005. On September 15, 2010, LNPS-II Unit 1 entered into commercial operations. On August 7, 2011, LNPS - II Unit 2 was put into commercial operations.

- **In accordance with the national objectives of “self-reliance in design, manufacturing, construction and operation”, local Chinese enterprises had undertaken the work in project management, engineering design, equipment manufacture and surveillance, construction and technical services of LNPS-II, with the equipment localization rate exceeding 50% for LNPS-II Unit 1 and 70% for LNPS-II Unit 2.**
- **To improve its safety and economy, the plant adopted 15 important technical improvements and more than 40 other improvements, including DCS, advanced control room, advanced fuel assembly and half-speed turbine.**

2. Role of DNMC in LNPS-II's operation preparation

LNPS-II is the extension project of LNPS. Operation preparation of LNPS-II depends on the existing capacity of DNMC. According to the Operation Preparation Consignment Agreement and the Operation Preparation Program for LNPS-II approved jointly by the general managers of the owner and DNMC, the operation preparation targets of LNPS-II are: to completely finish the tasks of operation preparation, train and develop an operation team with sufficient knowledge and skills, good at management, and high ethical work style so as to ensure safe, economical and steady operation after take-over of the units.

3. Main risk during operation preparation for DNMC

- **Quickly status change of unit and dilution of experienced operation staff**
- **From unloading to loading of nuclear fuel**
- **Complex site working conditions**
- **Complex interfaces between the owner and CNPEC**
- **New equipments with high failure rate**
- **Black box of DCS and other modified technology**
- **Poor behavior and human performance of New Staff**
- **Dilution of safety culture because of the drain of experienced and skilled Staff**

4. Methods to control the above risk

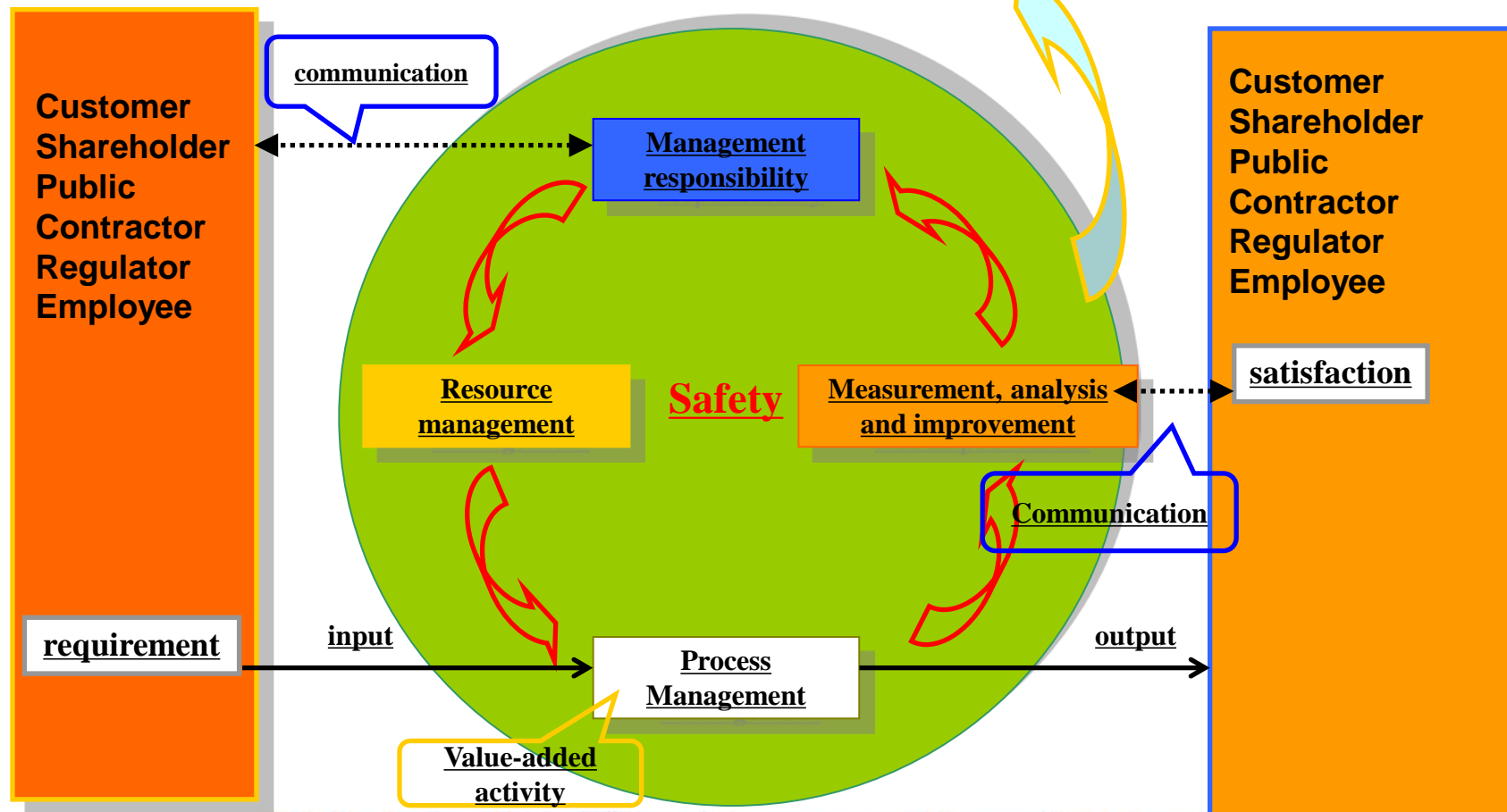
4.1 Extending DNMC's integrated management system

Based on China nuclear power quality assurance code since its founding, DNMC has been forming its integrated management system, by continuous digesting, absorbing and integrating of ISO9001, ISO14001, OHSAS18001, rebuilding business process, SAP on-line and introducing excellence performance model.

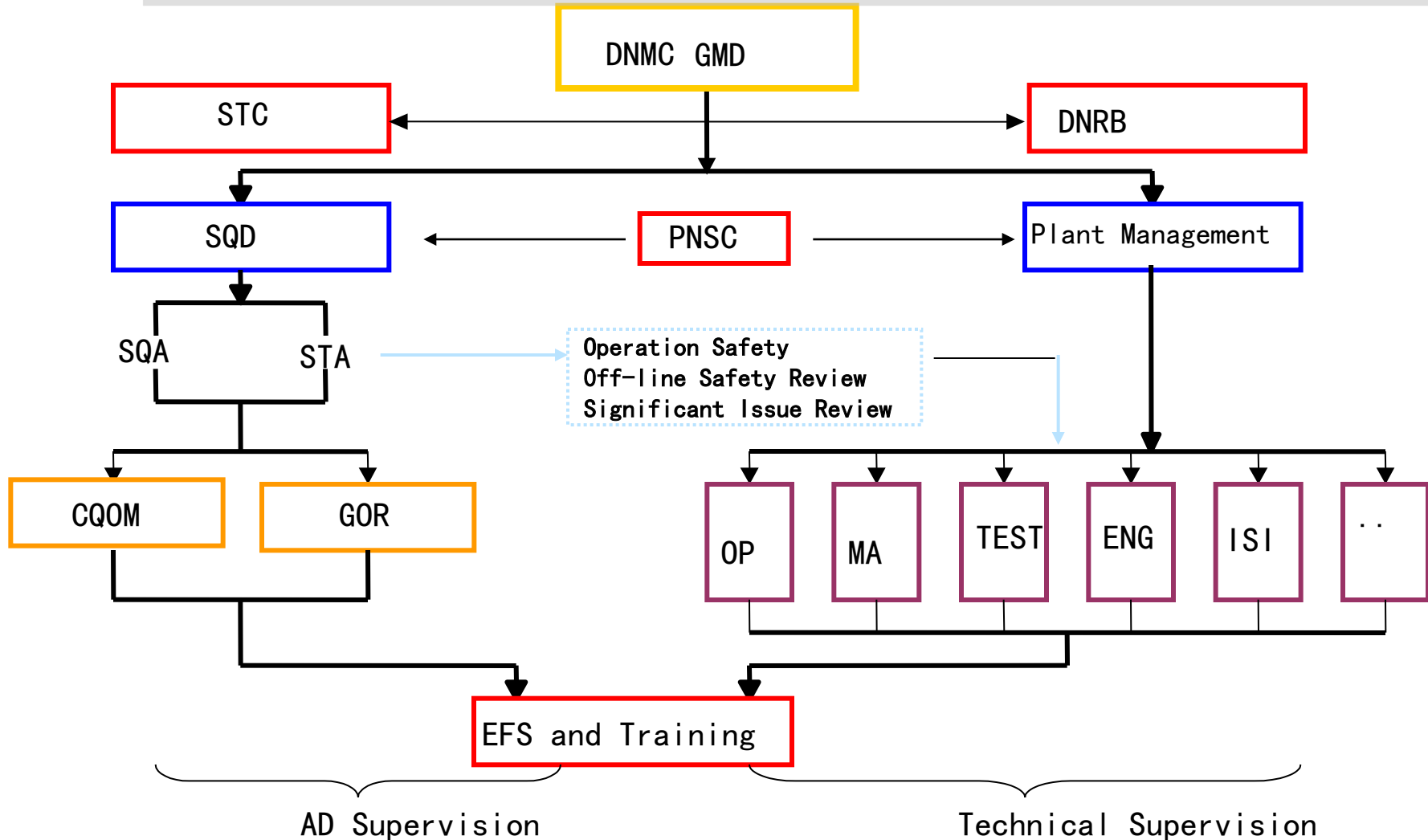
DNMC extended the management system to LNPS-II and made complete requirements for DNMC staff participating the operation preparation and interface with engineering side, along with a lot of special management innovation.

Integrated management system of DNMC

SAP Platform+Excellent Performance Model



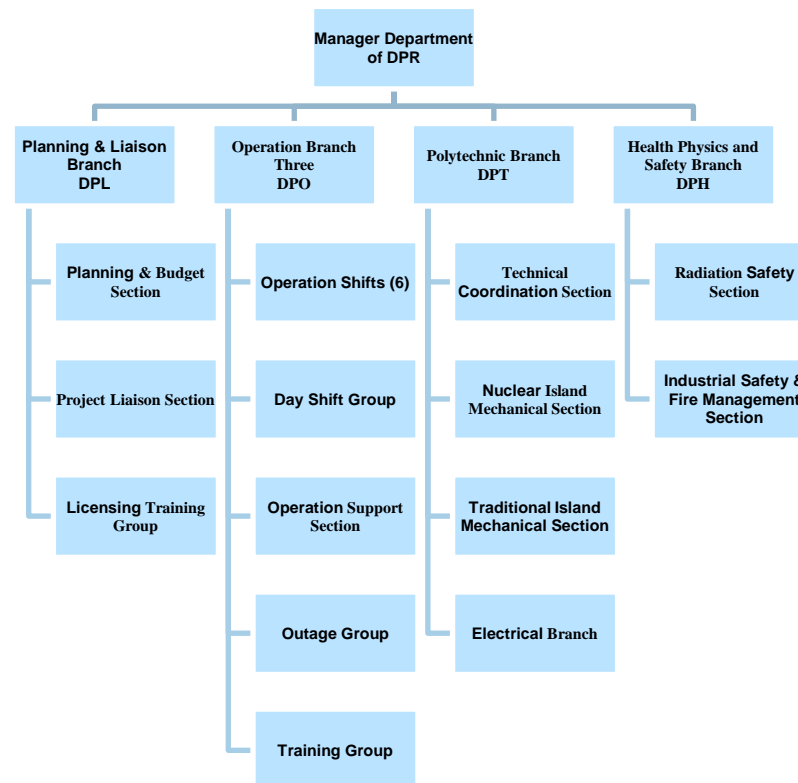
System Model for Safety Management



4.1.1 Management system for LNPS-II

◇ Organization Aspects

- From August, 2004, DNMC set DPR as the department specifically responsible for operation preparation of LNPS-II and initiate operation preparation before the main civil construction work.

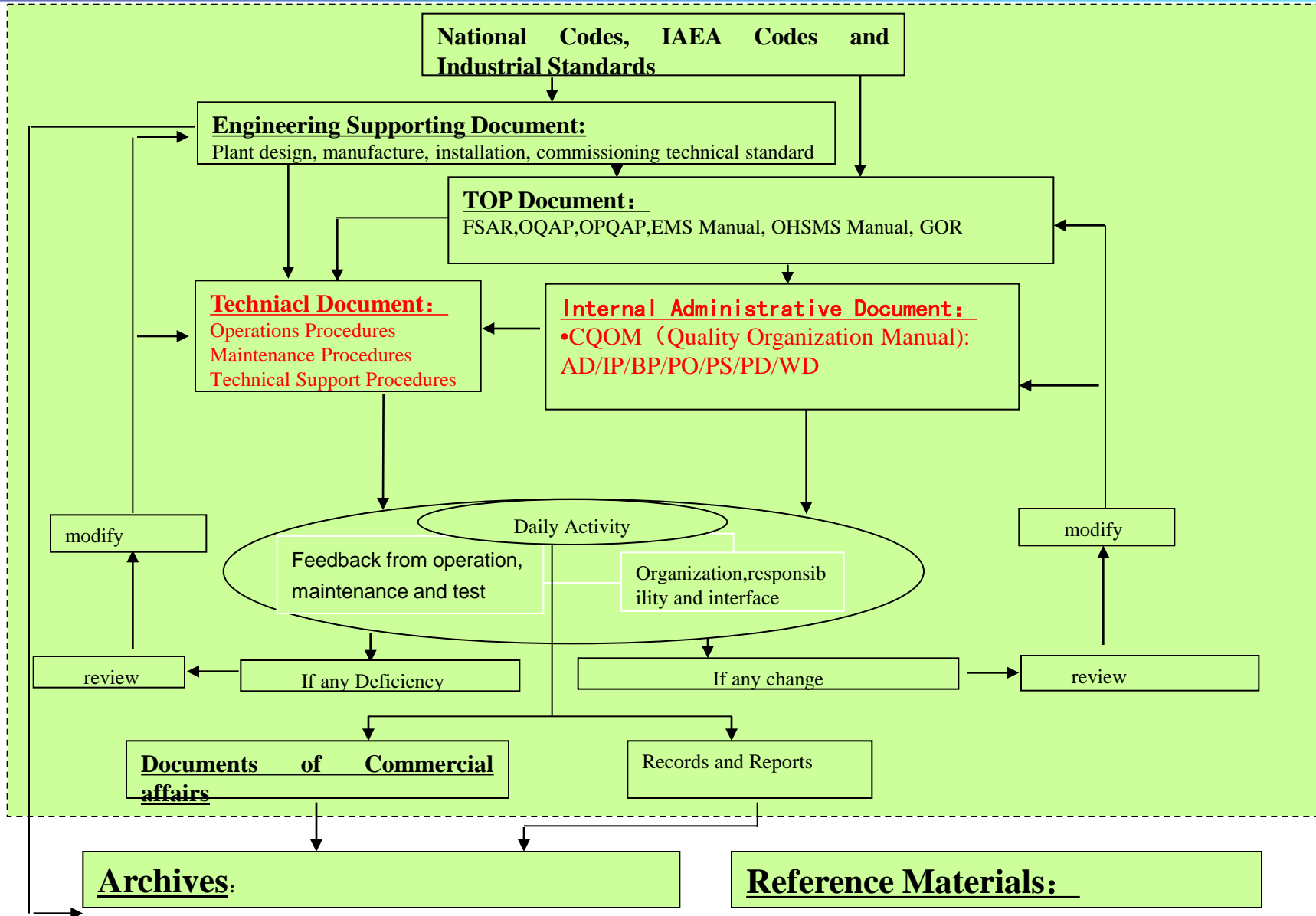


◇ Organization Aspects


-In order to coordinate and push forward operation preparation of LNPS-II, DNMC established the interdepartmental Operation Preparation Committee. A member of the General Management (GMD) of DNMC assumed the chairman, and the members of the committee include the deputy managers of the six departments directly related to operation preparation, and the manager of HRD as well as the branch heads of relevant implementation branches. The Committee holds the weekly meetings, and monthly meetings. to follow up and push forward the operation preparation work, and coordinate to solve the difficulties and problems in practice.

◇ Procedure Management System

- An *Operation Preparation Quality Assurance Program* was set up officially by the three parties and applicable to all the activities concerned with operation preparation related work, items and staff and contractors involved in the activities. These activities include organization management, design, procurement, manufacture, installation, construction, training, spare storage ,procedure writing, engineering experience feedback, documents turn-over, follow-up of pending issue, first on-loading application, equipment and system and building turn-over, cool and hot start-up , the first overall emergency exercise and first loading and trial operation.
- Under the program, DNMC wrote a series of management procedures and guidelines to describe more details of the requirement.
- And under these management procedures, technical procedures were developed including a lot of operation and maintenance.



Operation Preparation QA Program

 大亚湾核电运营管理有限责任公司 Daya Bay Nuclear Power Operations & Management Company, Limited (DNMNC)																															
原编制 处长 SQA BRANCH HEAD																															
岭澳核电站二期生产准备质量保证大纲 OPERATION PREPARATION QUALITY ASSURANCE PROGRAM FOR LNPS II																															
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版次 (Rev.) 11	附件数 (Appendices) 102																														
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DNMNC 岭澳核电站二期生产准备质量保证大纲		版次: 11 页: 3/50
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质量保证政策声明

作为大亚湾核电运营管理有限责任公司 (DNMNC)、岭澳核电站有限公司 (简称岭澳公司) 公司和工程公司总经理, 我们充分认识到保护厂区人员、公众和环境免受过量辐射和其它职业危害的职责。按照中华人民共和国国家核安全局 (NNSA) 颁布的核电站质量保证安全法规的要求, 并参考国际原子能机构 (IAEA) 的质量保证法规, 特建立此《岭澳核电站二期生产准备质量保证大纲》(OPQAP)。

公司将实施《岭澳核电站二期生产准备质量保证大纲》实现岭澳核电站二期安全、高效地生产准备及移交投产工作, 为员工创造良好的工作环境, 把环境影响降到最低程度, 保持公众对公司的高度信心。

本文件描述 DNMNC、岭澳公司 (CNEPC) 和工程公司 (LDNPO) 签署和执行的《岭澳核电站二期生产准备质量保证大纲》, 并明确规定这些质量保证要求适用于岭澳核电站二期所有与本大纲第一章所指定的安全和质量有关的生产准备活动。为保证安全、可靠和经济的准备和交接, 要求参与核电站生产准备活动及相关活动的每一个人遵守《岭澳核电站二期生产准备质量保证大纲》及有关程序要求。每项活动须由受控的人员, 使用合适的设备或工具以及正确的程序在合适的条件下进行, 要求员工及时识别和向负责人员报告不符合的情况并及时采取纠正行动。

我们授权 DNMNC 总经理部一名成员负责监督《岭澳核电站二期生产准备质量保证大纲》的有效执行, 公司各部门全面负责实施其各自范围内的《岭澳核电站二期生产准备质量保证大纲》, DNMNC 安全质保部负责制定和修改《岭澳核电站二期生产准备质量保证大纲》并监督它的执行情况和有效性, 在发现质量缺陷时有权要求责任单位采取纠正行动, DNMNC 安全质保部独立于其他各部门, 向总经理部报告工作。

应清楚地认识到在进行一项具体工作时, 对质量负主要责任的是工作执行人员而不是验证工作的人员, 但是应强调的是, 工作执行人员与工作验证人员都对获得质量做出贡献, 没有每个人的良好工作质量, 就没有核电站的安全保证; 提供与安全和质量有关的物料或服务供应商/承包商也要遵守他们各自的质量大纲, 以控制他们在各自范围内的活动, 而本公司的职责是使本大纲的总体有效执行。

质量、成本和进度相统一, 但质量目标的实现, 可使成本和进度目标更容易达到。没有质量的速度是资源的浪费, 为了保证《岭澳核电站二期生产准备质量保证大纲》的有效性, 高层管理部门要负责《岭澳核电站二期生产准备质量保证大纲》的策划、制定、实施以及有效运作。

《岭澳核电站二期生产准备质量保证大纲》的最终目的是提供一个系统的方法使工作一次成功。

DNMNC 总经理 高立刚	岭澳核电站有限公司总经理 朱志雄	工程公司总经理 郑东山
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■ The Contents of CQOM

chapter	contents	chapter	contents
0	Guideline for Documents Writing	14	Emergency Preparation and Response
1	Organization and Responsibility	15	Operation Planning and Gridding
2	Resource Management	16	Contract Procurement and Material Management
3	Operation Management	17	Document and Archive Management
4	Maintenance Management	18	IT Management
5	Check, Surveillance and Test Management	19	Security
6	Fuel Management	20	Internal Audit and Control
7	Engineering Management	21	Finance and Accounting Management
8	Equipment Management	22	Administrative and Logistical Management
9	Nuclear Safety Management	23	Insurance Management
10	Experience Feedback Management	24	Science and Technical Management
11	Occupational Safety Management	25	Party and Crowd Management
12	Chemistry and EMS	26	Confidentiality and Property Protection
13	Quality Assurance	27	Operation Preparation

■ Procedures for LNPS-II under CQOM

Procedure Type		Writer	Total
Management	Procedures special for operation preparation	DPR	80
	Common procedures in CQOM)	DNMC	600
Technical	Operation procedure	DPO	1055
	Maintenance procedure	DPT/MIC/MGS	3729
	Maintenance program	OPE	313
	Occupational safety	DPH	872
	Chemistry	OPC	127
	Technical support	TTS	177
	Other technical procedures	TCW/SNS	100

◇ Main Management Innovation

- A Units Start-up Committee was established as the highest director organization for CNPEC and DNMC both with one member respectively from it's GMD as chairman. They held meeting every month to discuss major issues affecting safety, quality and progress, and made important decisions mutually.
- A three-level decision system was also established to effectively and efficiently deal with issues affecting safety, quality and progress. The three levels are engineer level, branch level and department level. They held meetings daily and weekly with engineering side and report to their line-manager.
- A safety assessment committee was also established to give review opinions. They held meetings by-weekly.

◇ Main Management Innovation

-staff was required to participate in the fields deeply as follows:

- Attending the daily morning meeting, planning meeting, expert meeting.
- Planning engineer and operators and STA worked at the same office, in order to control the activity risk as an united planning group
- Before significant test activity and high risk work, technical discussion meeting, pre-job briefing and briefing meetings were also required.

-Managers were required to focus and patrol on site.

-Safety and quality surveillance were enhanced :

- STA began to shift before fuel loading for on–line monitoring, sorted and analyzed DHP pending problems list, and followed-up and verification of GOR9 periodic test every day.
- QA Branch set up a special section and allocate engineers to carry out audit and surveillance at the beginning of operation preparation.

4.2 Effective Safety Culture Construction

The safety culture construction of DNMC is in fact a multi-leveled and systematic engineering, and its general ideas can be summarize as:



4.2.1 Safety Culture Lecture and Plant Patrol of Managers

□ Safety culture instructions given by management

In DNMC, managers of different levels are required to give various safety culture lectures to publicize the policies of safety culture to the staff and interpreting the idea of that.

This mechanism has been institutionalized and incorporated into the annual training plan of the company and DPR for all the operation preparation staff

总经理部成员进行系列讲座第三期——《安全文化》讲座

提供者: P201039 提供单位: 技术部培训中心 提供时间: 2006-6-29 16:32:26



□ On-site patrol made by management

From the general manager to basic-level cadres, they all spend some times in observing personally the work at the site every month.

Through these means, the supervision and control on-site could be efficiently strengthened, and the problems could be found and solved at the same time. The correct explication of safety culture could be given by leader, with his personal participation and demonstration.

Example: General Manager's patrols on LNPS-II

卢长日总经理巡视岭澳二核1号机组

提供者: [P300916]白乐峰 提供单位: 生产准备部 提供时间: 2010-10-23 13:18:06



郭利民副总经理到岭澳二期现场检查生产准备工作

提供者: PTENDLL 提供单位: 生产准备部 运行三处 提供时间: 2009-11



4.2.2 Facilitating Team of Safety Culture and Human Performance Improvement

This team constitutes a group of enthusiastic and experienced guys of different professions and ranks in DNMC. All members of the team come from important posts; they are representatives both in profession and in hierarchy.

The team continuously learned knowledge and translated a series of books on INSAG safety culture reports, providing the basis and reference for safety culture development and practice in DNMC. It also actively exchanged ideas with such international organizations as IAEA , WANO, EDF and RINPO.



□ Safety culture training reference books

4.2.3 A Series of Shocking Training Courses

The “shocking training courses” is mainly lectured by members of General Management. In this educational activity, leaders together with the staff will review the achievements of the company and reveal deep rooted problems of the Company, through bench marking with international and national NPPs.

The GMs will review and re-analyze previous significant safety-related events in production, and extended to the feedbacks of safety events happened in some high-risk industries. Through the retrospect of the past and the analysis of existing work-related problems at the present stage, the training may be ended with such a conclusion,” more often than not, an accident comes from a minor deviation and a consequential result comes from a minor error and the tolerance of the minor error”.

The 19 May 2009—— A Safety Shock Education has been organized for the 5th anniversary of Accident 5-19.



敬畏安全担责任、内外兼修重内功——运营公司全员安全文化震撼教育活动系列报道之五

提供单位：【P200096】嘉兴核电运营公司、党群工作部 提供时间：2010-6-2 10:33:41



汲取教训 防范风险 苦练内功——运营公司全员安全文化系列教育讲座之三

提供单位：【P200096】嘉兴核电运营公司、党群工作部 提供时间：2010-6-2 16:07:17



2008年运营公司“安全月”活动系列报道之九：运行三处举行安全文化继续教育活动

提供者: PTENDL 提供单位: 生产准备部运行三处 提供时间: 2008-6-26 14:19:46



2008年运营公司“安全月”活动系列报道之十：职业安全处开展核安全文化再教育

提供者: P205630 提供单位: 生产准备部职业安全处 提供时间: 2008-6-26 15:11:11



4.2.4 Other Flexible Training Types

DNMC pertinently and creatively carried out all sorts of practical activities concerning safety culture in various fields, such as the Special Activity Commemorating the 20th Anniversary of the Chernobyl Accident, the Safety Culture Sketch Contest, the Human Factor Tool Card DV Competition, the Debate on Safety Culture, the Safety Culture Cartoon and Story-telling Competition, the establishment of warning education exhibition room and the like.

Via these activities, the staff including operation preparation staff can learn a lot from the shocking experiences of our own and world-wide

Video competition of Interrogative Attitude



□ Short play competition

The “Short play competition” is considered as an very important part of its activities in the safety month 2009 of DNMC.



□ Debate about Safety Culture

运营公司安全文化辩论赛决赛圆满落幕

提供者: P203062 提供单位: 运营公司团委 提供时间: 2006-9-28 15:15:13



4.3 Human Performance Improvement

□ Progress of DNMC Human Performance Project

-During the period from 2003 to 2006, the theory and method of human performance was introduced and popularized to personnel of various managing hierarchies.

-During the period from 2006 to 2008, six tools for human performance were developed and each branch formulated the “behavior standards” and some branches carried out pertinent behavior trainings.

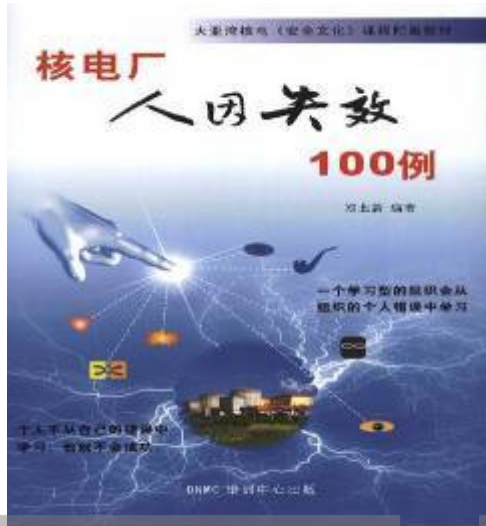
-From 2009 to now, various human performance trainings and practices have been fully carried out and various measures like the management of minor deviation on the site and the setup of human clock have also been initiated.

□ Several Major Aspects of the HU Project

In order to standardize the operations of site personnel and reduce human errors, key behaviors or action standards of operation procedures that serve to provide general guidance were formulated, thus further putting the basic ideas and requirements of the safety culture into practice in the process of the site work.

In 2006, DNMC initiated the development of the “tool cards for human performance”. So far, DNMC has issued and promoted six tool cards for human performance: “pre-job briefing”, “procedure use and adherence”, “self check (STAR)” “peer check”, “three-way communication”, “questioning attitude”, the tool card “1-min stop” is just under popularization.

-Human error reduction training



Thinking method of engineers
DNMC in prevention of human
errors

Editor Zheng Beixin

March 2005

Thinking method of
maintenance directors in
prevention of human errors
(one of textbooks DNMC in
prevention of human errors
)

Editor Zheng Beixin

June 2004

Human errors experience
feedback of unit outages
— NTC/Experience
feedback Section —




Editor Zheng Beixin

September 2003

-Development and widespread use of human performance tools cards



- Training rooms and scenarios of 6 tools cards

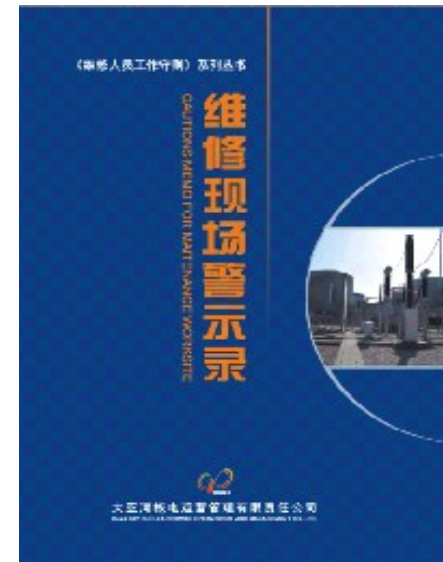
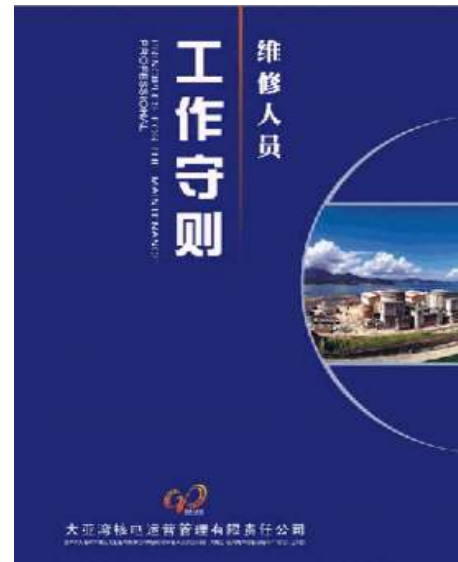
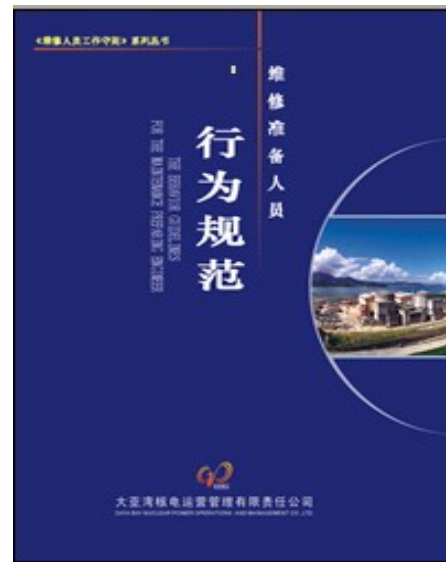
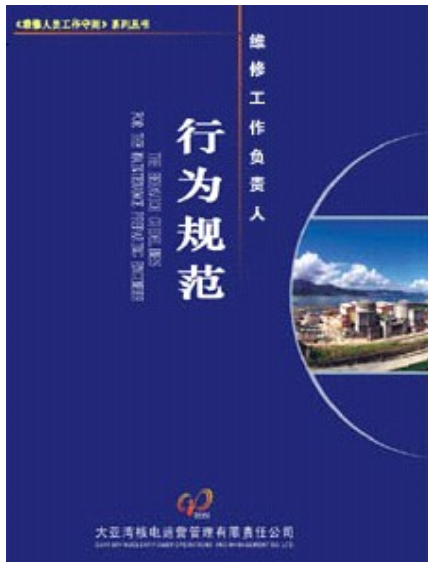
<p>三段式沟通 3-phase Communication</p>  <p>JE301B</p>	<p>质疑的态度 Questioning Attitude</p>  <p>JE302B</p>	<p>工前会 Pre-job briefing</p>  <p>JE303B</p>
<p>程序使用 Procedure Use & Adherence</p>  <p>JE301A</p>	<p>STAR自检 Stop-Think-Action-Review</p>  <p>JE302A</p>	<p>监护操作 Peer-checking</p>  <p>JE303A</p>

-Behavior standards

Code	Content
CO-01	Reading loudly the text in work orders in pointing to them.
CO-02	Supervision: re-reading the text in touching them on the paper, and checking the content then tick it.
CO-03	Three-way communication during giving operation orders.
CO-04	Ticking on the procedures
CO-06	“TPL” lit during temporary operations
CO-07	Saying OVER when the telephonic communication finishes.
RO-01	Supervising the P panel during dilution or boration operations.
BM-01	Re-reading and checking when inputting orders
BM-02	Writing the information of local blocking operation
BM-03	Looking through the work orders during the removal of blocking
BM-04	Checking independently the information of removal of blocking

Code of conduct for operation staffs

-Behavior standards



Code of conduct for maintenance staffs

4.4 Construction of eminent teams in safety culture

The establishments of eminent teams are organized and carried out by each department.

维修部安全文化创建班组

班组名称: 电气外继电保护科
创建单位: NEE
责任处长: 吴翎 (TEL: 79909)
责任科长: 段贤稳 (TEL: 79548)
班组长: 段贤稳 (TEL: 79548)
本处接口人: 高翠兰 (TEL: 76939)
班组办公室: LAF130



完善的管理制度 明确的工作职责 充分的技能授权 规范的人员行为
 质疑的工作态度 严谨的工作方法 互相交流的习惯 安全第一的意识
 一次就把事情做对 人人都是一道屏障
 四禁一严

4.2. 评选标准

以下指标按月进行汇总，并在年底计算总分：

指标分类	指标内容	指标上限	加减分标准
安全	本组责任的人因 LOE	0	每次“-10分”
	本组责任的 1 级火险事件/工业安全事故	0	每次“-10分”
	本组责任的个人受照剂量大于 20mSV	0	每次“-10分”
	本组责任的人因 IOE	0	每次“-5分”
	本组责任的 0 级火险事件/工业未遂	0	每次“-5分”
	本组责任的人因地面沾污/体表沾污	0	每次“-5分”
	本组责任的人因 24 小时事件	0	每次“-1分”
	本组责任的重发人因 24 小时事件	0	每次“-5分”
	本组责任的人因 24 小时事件单填写 (以本处人员填写的为准)	0	每遗漏 1 份,“-0.5分”
	24 小时事件单填写数量 (包括其他部门责任和设备)	0	每份“+0.25分”
维修质量及效率	辐射防护/工业安全发出的整改通知、质保发出的 HCAR	0	每次“-5分”
	本组负责的重大敏感设备可用率	100%	由于本组负责的设备系统故障导致停机、停堆、降负荷 200MW 以上的, 每次“-10分”; (本项与人因 LOE/IOE 不重复扣分)。
	重复性维修次数	0	每次“-1分”
	再鉴定一次不合格	0	每次“-1分”
	重发重复性维修次数	0	每次“-5分”
	维修完工报告完整	一一	每遗漏 1 份“-0.5分”
设备巡检按时完成 (巡检记录不全的按未完成计算)	一一	每遗漏 1 份“-0.5分”	

4.5 A complete Skill Training Center



4.6 Self-Evaluation (Learning Organization)

4.6.1 Internal Self-evaluation

- By indicators
- By self-evaluation
- By management self-evaluation
- BY CGNPC

4.6.2 External Evaluation

WANO and IAEA are periodically and actively invited to conduct peer reviews. In 2010, IAEA conducted an official review on LNPS-II before its commercial operation. All the findings were developed and improvement of business planning in DNMC were made.

岭澳二期生产准备外部评估拉开序幕

提供者: P990086 提供单位: 生产准备部 刘俊杰 提供时间: 2008-10-29



岭澳核电站二期Pre-OSART活动开幕

提供者: P201132 提供单位: 曹丽苹 提供时间: 2009-11-18 15:14:01



5 Conclusion

Since the commercial operation of the two units of LNPS-II as schedule, LNPS-II keep its safe and stable operation without unplanned shutdown or scram during its first cycle.

The safety culture needs to be concretized so that ordinary employees can truly understand the nature of the safety culture and consciously apply their understanding to their behaviors, thus making contribution to the development of the safety culture.