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JOURNEYS OF PSM IMPLEMENTATION AT TAIWAN FPG

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ABSTRACT

Formosa Plastics Group (FPG) was found in 1955 as a small private company. Over time, through acquisitions and advanced growth, the company has now grown to its current size with total sales of 79 billion US dollars in 2014 including business of chemical, petrochemical, medical, electronic, automobile, etc. To sustain the healthy economic growing in the early of 90s, FPG constructed a naphtha cracking project so called "Sixth Naphtha" through the land reclamation with total of 8 kilo meter long by 6 kilo meter wide located at Mailiao of Yunlin County. Up to date, 65 units were operated in this complex.

In late of 2010, Mailiao Complex experienced several fire accidents. The Mary Kay O'Connor Process Safety Center (MKOPSC) was requested to conduct studies and investigations. The objectives of the study were to evaluate the complex operational and safety practices. A recommendations report was presented to top management officials in 2011.

By the direction of designated Environmental & Safety Official, a series of renovation on Safety especially PSM aspect was take into consideration. This presentation describes the experience of transformation and results of cooperation with MKOPSC since 2010. The structure of safety organization was reformed to respond the needs of process safety performance. Each element of PSM program was reviewed and enhanced. Third parties were brought in to review PSSR when a unit turnaround was performed. Independent third parties were conducted PSM auditing to address safety culture of the corporation and company risk ranking matrix issues.

Through these years, FPG has committed to follow up international best practices in PSM aspect. Government regulations, company procedures and site-work safety practices are the first priority for the PSM Implementation. A series of PSM employee training is in place. The personnel from MKOPSC were invited again to review the progress of PSM implementation. The report demonstrates that the dramatic improvement has been achieved.

However, Process Safety, like success, is a journey. Teamwork and participation from every employee on a sustained basis represents success of PSM implementation.

Three Aspects of FPG's PSM Implementation

Crisis for FPG's PSM Program

During Jul. to Aug. 2010, several fire incidents occurred at FPG's Mailiao Complex. FPG were ordered by the government to shut down the plants to perform safety inspections and review our process safety mechanism. After one year, from Sept. 2011 to Sept. 2012, FPG requested third party consultants, to conduct IV&V (Independent validation and verification) for operational hardware to software in our production system.

Independent validation and verification Program

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|-----------------------------------|--------------------------|
| ◆ Failure Investigation Analysis. | ◆ Process Safety Review. |
| ◆ Mechanical Integrity. | ◆ Shutdown Inspection. |

An opportunity for PSM overhaul

The safety incidents and IV&V initiative really gave us a very good opportunity to scrutinize what went wrong with our PSM program. In order to improve the safety of our industry complex, we invited Dr. Sam Mannan of Texas A&M to perform a diagnoses of PSM Implementation. As result of the overall review, he gave FPG total of 38 suggestions with 5 categories to improve our performance. His staff also conducted incident investigations in our complex during the review. Besides that, we also recommended some other companies for the programs such as MI assessment, Facility Siting, and PHA review.

PSM Program 38 recommendations

■ Organizational- <u>Board Oversight</u>	■ Facility Siting-based on API RP-752
■ Organizational- <u>FPG Center of SHE Role</u>	■ Process Safety Management (PSM) Program
■ Organizational- <u>Mailiao</u>	■ Process Hazards Analysis (PHA)
■ Outreach Issues	■ Management of Change (MOC)
■ Systematic Issues	■ Emergency Response Program
■ Mechanical Integrity Program	

The major recommendations that Dr. Mannan made for us. Basically they belong to 5 major categories, such as Organization strengthening PHA, MOC, MI Auditing and incident investigation.

The following 5 items Improvement projects should be prioritized	
❖ Process Safety Program Review.	❖ Incident Investigation.
❖ MI assessment Program.	❖ PHA Review Program.
❖ Facility Siting Project.	

New Thinking in the PSM Program

Organization is always a very important issue to the initiatives such as PSM program. Therefore, to improve our capability to for improving PSM performance, the 7 members of the FPG Executive Board determined the project for improving the industrial safety and environmental protection on August 15, 2010. Vice-chairwoman, Ms. Susan Wang was selected to be as an Environmental & Safety Officer.

Furthermore, we also reviewed FPG's SHE organization and manpower resources. For example, we re-organized the SHE Center (esp. in Mailiao complex) : The Corporate group of SHE Center was expanded from 86 to 161 people. Each unit of FPG has a full-time contact window on SHE affairs at any administration level.

Meanwhile, we established an corporate-level Technical Specification Team in 2012 to figure out the practices of other related industries and set up standards. We also established the Technical Training Center at Mailiao complex in 2011, to enhance and develop the technical talents of the employees and contractors. To implement the around-the-clock public pipeline inspections, the staff numbers of the Public Pipeline Dept. was increased from 43 to 114. The last major piece of re-organization was to group the Accidents Investigation Committee in 2011. The committee runs investigation assignments and sets up investigating procedures to make sure the investigation is practical.

Occupational Safety

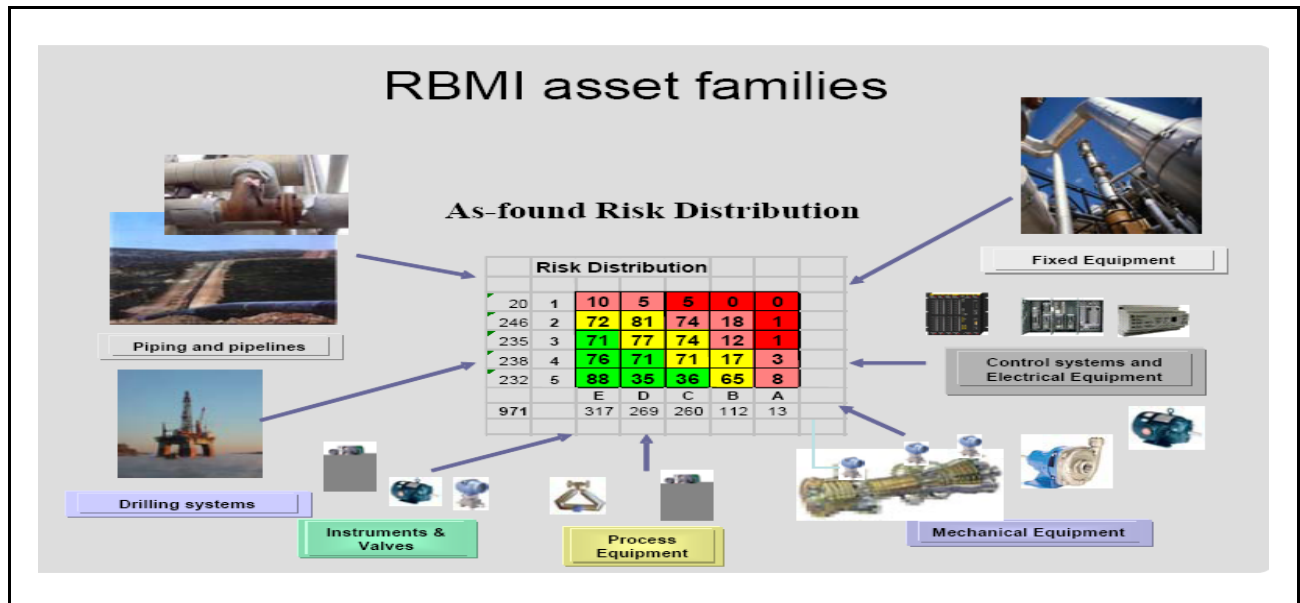
First...talk about Occupational Safety. In order to ensure the work safety and enhancement of the supervision, total of over 450 safety supervisor jobs were created. We provided them training courses learned from several industrial countries, according to their duties. All safety supervisors were required to be certified before working on-site.

Mechanical Integrity

Mechanical Integrity is a big chunk of PSM entities. To reinforce MI, we have established the predictive maintenance departments in each company since June 2012. We also set up the Authorized Inspector (AI) System by utilizing API certified inspectors. To promote engineering capability of MI, we introduced advanced maintenance technology from Singapore in recent years.

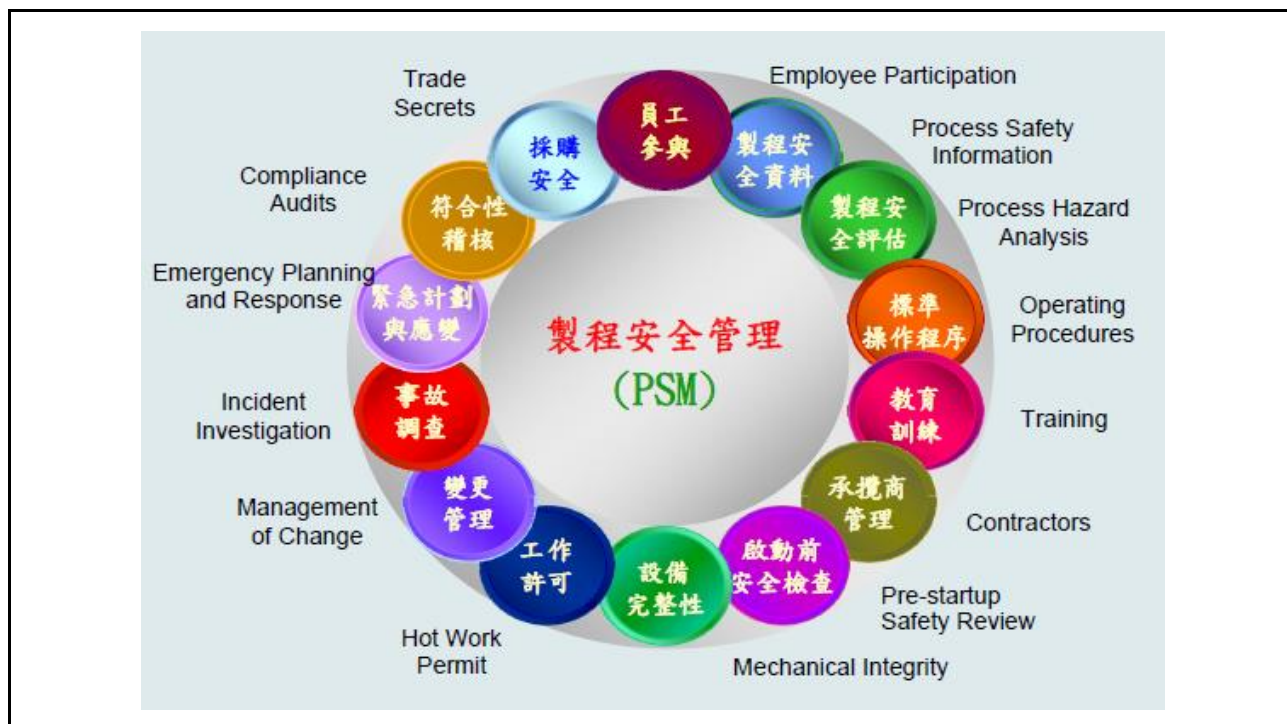
In order to promote the MI project as soon as possible, FPG-Taiwan conducted the professional software-RBMI. In 2010, RBMI was carried out in Mailiao Complex. FPG has assigned 4 pilot plants to implement the pipeline RBMI project. Currently it's carried out throughout the complex.

Corrosion is also a key issue in MI. We have been holding technical seminars and circulating newsletters to increase anti-corrosion awareness and knowledge since 2012. Now a meeting is held for all AI's every quarter. In the meeting, each company presents their improvement projects to the participants and sharing the knowledge through the electronic newsletters.



Mailiao is a place with windy winter. The air contains a high level of salt. Therefore pipeline anti-corrosion is so important for us to work on at the complex. In order to prevent pipeline leakage that could causes major incidents, we implemented the public pipelines improvement project to efficiently resolve the problems of the complicated pipelines system. In the project, 139 new pipelines with a total length of 345 km were installed. Ninety one existing pipelines with a total length 155 km were replaced. Detail QRA project was required before these pipelines were installed. On each floor of pipe racks, inspection aisles were added and the distance between pipelines was widened from 5 to 15 cm for maintenance purposes. Furthermore, Aerogel was applied for pipeline insulation to prevent from CUI (corrosion under insulation).

Process Safety Program



In order to reinforce process safety, FPG has a series of initiatives as shown here.

1. SHE Manpower review in Dec. 2010 : To comply with the industry's best practices in PSM, FPG designated PSM Coordinators at all levels. who are in charge of promoting and implementing PSM-14 elements. There are 236 persons throughout the FPG.
2. For those higher risk units, the coordinators to be dedicated full time duty to PSM projects. 87% of them in Taiwan are full-time and 53% are senior engineers with more than 15 year working experience at FPG.
3. To ensure that the coordinators work effectively, we have cleared Job descriptions, Training programs, Certification procedures...etc.

We also have developed computer programs to build up the platform for exchanging experiences in PSM aspects. To enhance the quality of PSM project for each company, four major companies takes turn to present PSM related issues and share the experiences of PSM implementation with every company four times a year.

In order to enhance the PHA skills, in Oct.2010-Jan. 2012 Formosa requested a third party to assist for PHA training and consultation. Each company selected a plant for the PHA Review program. The risk assessment PHA training was done at the same time.

After the program, all companies to prioritize and complete the PHA review for those high risk processes by May 2012.

In order to enhance the quality of risk assessment and training, we have assigned designated personnel to take charge in Formosa in PHA facilitation. All facilitators are trained and certified by a third party. Now we have 57 certified PHA Facilitators in Taiwan and 15 in China. Besides that, we also conducted a PHA Team Leader Training Project in 2014. Among those 120 people trained, 47 passed certification.

FPG developed its own web-based e-RMP (electronic Risk management platform), since 2010. PHA information is one of the most important parts of the platform. Below is the screenshot of its our own homepage.

Since 2013, FPG have implemented LOPA requirements. Those processes which have Level 1 or Level 2 with high risk rankings need to perform LOPA.



登入用戶:台塑集團\台灣塑膠公司\測試帳號DP2 登入時間:2012-12-06 10:34:28

[OAA1] 公告 [LCA4] HAZOP分析

製程單元 節點 備註 HazOp LOPA 改善方案

高雄管理課\資料壓力測試區\1. CTA粉經過E-709A/B/C預熱熟至286度C. 經由V-710緩衝後送至氯化反應器R-713(反應溫度:286degC. 反應壓力:75kg/cm2G)將4CBA氯化為對甲苯甲酸再送至第一結晶罐K-801\低流量/無流量

低流量/無流量

*Q	衝擊事件 Impact Event	*R	後果分類 Cat	嚴重度 S	目標頻率 TMEL	*S	起始原因 Initial Cause	可能性 PFB	*T	保護層類別 IPL Cat	保護層 IPL
001	氫氣無法入料, 造成無產量, 停車1天. 產能損失135萬/天.sdsdas	001	EFL	2	0.0001	001	H2管線(H2-7001E-1'-OE1-H75) FV-71309-2前後手動閥錯誤全關。(0.01)	0.1	001	AM-IPL	PDAH-713 (0.1)正確(Flame/d properly maintain
									002	AP-IPL	FAL-713
									003	SIS-IPL	F-714B-2 (0.1)
002	R-713-2本身無液無流動(無流量)氫氣及氯氣進料造成R-713-2高壓,導致氯氣可能發生夾流反應, 溫度上升, 導致超壓, 氯氣外洩, 發生火災及人員傷亡	001	ES	3	0.001	001	R-713出口管線(PF-7027-8'-HD1-H125)控制閥HV-71301-2異常全關。(0.1)	0.1	001		PIC-713
									002		LIC-713
									003		PAH-713
									004		TAL-710
									005		PS-7131
									006		FV-7130
									007		PSV-706
									001		現場設置
		002	PSE	4	0.01	001	R-713出口管線(PF-7027-8'-HD1-...	0.1	001		PIC-713

Three steps for FPG's PSM in the future

FPG's PSM in the future

First of all, the establishment of Safety Culture: In May 2015, our Vice chairwoman instructed plant managers and higher management with "The FPG safety culture roadmap". It revealed the key issues that FPG has to work on with safety aspect. They are :

Key-1 To put safety as the first priority for all the management levels.

Key-2 To reinforce process risk management.

Key-3 To emphasize lessons learned from incidents.

In recent years, we started a safety culture award program to encourage the safety climate. In 2015 we had the 3rd safety culture awards ceremony in Mailiao complex, Vice Chairwoman presented Vision 2016. They are as follows:

1. The group should actively comply with international standards, to learn the industry's most effective management practices.
2. Strengthening FPG's safety culture at oversea sites.
3. The establishment of a positive safety culture.

In the future, we are going to ensure PSM implementation and performance through routine third party audits. In addition to the internal compliance audits, audits and surveys from outside experts or institutes will be in place to confirm the implementation of the PSM.

In the past 3 years, we have done several third party audits, for examples:

In 2013 we had third party audit for PHA/MOC by Taiwanese company.

In 2016-third party audit for PSM Program by Taiwanese company.

In 2014 and I 2017 we invited Dr. Mannan from Texas A&M of MKOPSC and his team to conduct PSM review for us.

Meanwhile we emphasize and monitor PSM performance through key indicators. We referred to the international standards and relevant guidelines issued to "PSM performance indicators procedures" in 2013. Now there are 5 Leading indicators and 5 Lagging indicators in our monthly statistics. Furthermore, we have also been building the KPI module in our e-RMP since March 2014. Every quarter, the SHE Center compile KPI reports to monitor the achievement of PSM of the plants and enforce necessary improvement measures.