INTERNATIONAL CYANIDE MANAGEMENT INSTITUTE

Cyanide Production Summary Audit Report

For the International Cyanide Management Code

TAEKWANG Ind. Co., Ltd. PETROCHEM #3 Plant

23 February 2011

Name of Cyanide Production Facility	TAEKWANG Ind. Co., Ltd. PETROCHEM #3 PLANT
Name of Facility Owner	TAEKWANG Ind. Co., Ltd.
Name of Facility Operator	Mr. Jin-Hwan Jo
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Location detail and description of operation:
The PETROCHEM #3 PLANT of TAEKWANG Ind. Co., Ltd. ("TAEKWANG") is located at the Ulsan Petrochemical Industry Complex. The whole area covered by TAEKWANG is 89,570 ㎡, with its cyanide production facilities (inclusive of subsidiary facilities) accounting for 7,000 ㎡. The cyanide factory includes all facilities related to production, storage, and consignment. The cyanide produced by TAEKWANG is sodium cyanide used for gold mining. This sodium cyanide is produced using the hydrogen cyanide (HCN) generated from the acrylonitrile process as raw material. The product is available in briquette form. TAEKWANG employs total 120 staff in its production facility. The utilities used at the TAEKWANG plant, such as electricity, water, etc., are being provided by the petrochemical support center. TAEKWANG established and maintained safety and environmental policy and procedures with the reflection of Korean laws such as Industrial safety & health Act & Environmental Act. Those are strictly controlled by the relevant supervisory authority because the plant is located at the petrochemical industry complex.
The initial verification for ICMC was conducted during December 2007 to March 2008 and finally certified and registered at April 14 2008. Almost 3 years were elapsed since initial verification, so recertification audit was conducted during 19 & 31 January 2011 and 01 February 2011.
During this recertification audit, auditor team could confirm the following :

"This operation has not experienced compliance problems during the previous three-year audit cycle."

Auditor's Findings

This operation is

X in full compliance
☐ in substantial compliance *(see below) with the International Cyanide Management Code.
☐ not in compliance

* For cyanide production operations seeking Code certification, the Corrective Action Plan to bring an operation in substantial compliance into full compliance must be enclosed with this Summary Audit Report. The plan must be fully implemented within one year of the date of this audit.

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Date(s) of Recertification Audit : 19 & 31 January 2011 and 01 February 2011

I attest that I meet the criteria for knowledge, experience and conflict of interest for Code Verification Audit Team Leader, established by the International Cyanide Management Institute and that all members of the audit team meet the applicable criteria established by the International Cyanide Management Institute for Code Verification Auditors.

I attest that this Summary Audit Report accurately describes the findings of the verification audit. I further attest that the verification audit was conducted in a professional manner in accordance with the International Cyanide Management Code Verification Protocol for Cyanide Production Operations and using standard and accepted practices for health, safety and environmental audits.

Signed

TAEKWANG Ind. Co., Ltd.
PETROCHEM #3 PLANT

Name of Production Facility

Lead Auditor Signature

Date : 23 February 2011

Auditor Signature

Date : 23 February 2011

1. OPERATIONS: Design, construct and operate cyanide production facilities to prevent release of cyanide.

Production Practice1.1: Design and construct cyanide production facilities consistent with sound, accepted engineering practices and quality control/quality assurance procedures.

	X in full compliance with	
The operation is	☐ in substantial compliance with	Production Practice 1.1
	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
The situation was unchanged from initial verification during 2008 year. The plant was constructed during 1996 and operated at April 1997. Before the construction, facility & piping material were tested by competent suppliers. The construction company implemented test and inspection according to quality plan and submit the results to technical team & supervising agency. Technical team & supervising agency reviewed the result reports and concluded that facilities were established according to drawing & specification. The cyanide process has receive the PSM (Process Safety Management) inspection by KOSHA (Korea Occupational Safety & Health Agency) & Ministry of labor every year by Korea legal requirement. According to the inspection reports from KOSHA, TAEKWANG Ind. Co., Ltd. continued operation within established parameters and protection against cyanide exposure and release. Inspection records related to QA/QC & inspection were maintained. And also the materials used for construction are compatible with hydrogen cyanide, liquid sodium cyanide and other reagents. ESD(Emergency Shut Down) system and automatic interlock system were established to shut down production system and prevent release due to power outage or equipment failures.
To prevent cyanide seepage to subsurface, all cyanide process facilities including condensation, reaction, centrifuge, drier, packaging, storage and pipeline were established and controlled on concrete. Level gauge and alarm system were applied to cyanide process and storage vessels to prevent overfilling & overflow. Secondary containment and dikes were installed enough to contain spilled cyanide & cyanide solution. And also cyanide solution pipelines were covered by outer piping to prevent spillage of cyanide solution.
Since the initial verification during 2008 year, there are total 15 cases of facility changes such as capacity increase for dry blower, sodium hyper chloride feed line change in waste water treatment facility etc. Those facility changes were completed under the change control procedure TACE-09004. For each case, change control committee was opened. The change control committee checked quality, environmental and safety issues and finally approved the changes. After the facility changes, technical team inspected the changed facility, revised operation manual, trained operators and maintained inspection reports and training records. The quality control and quality assurance records including test & inspection reports from engineering & construction company and review results by technical team were maintained. And also records generated from change control committee and test & inspection reports from external agency were maintained according to record control procedure.

Production Practice 1.2: Develop and implement plans and procedures to operate cyanide production facilities in a manner that prevents accidental releases.

	X in full compliance with	
The operation is	☐ in substantial compliance with	Production Practice 1.2
	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
Production Team & Safety Team have established and maintained process operation manual in which standard practices such as operational criteria for pressure, temperature and flow were defined. They maintained start-up & shut down manual, preventive maintenance procedure and emergency preparedness to assure safe and sound process operation. They also established and maintained emergency preparedness plan to control the possible emergency situations such as spillage, hydrogen cyanide leakage, fire & explosion and cyanide exposure. They tested those emergency preparedness periodically. They established and maintained change control procedure in which identification and control of change were defined. Facility technical team established and implemented preventive maintenance program.
Main process parameters as flow rate, temperature and level were monitored by DCS and monitoring equipment was calibrated according to calibration procedure. Cyanide solution and cyanide contaminated water shall be treated in WWT and prevented unauthorized & unregulated discharge according to waste control procedure. The solid waste were collected and dispatched to qualified sub-contractor according to waste control procedure. The cyanide products were filled and packed in drum and wooden box and stored in warehouse in which ventilation fans were installed and operated to prevent exposure of moisture according to packaging procedure in which the IMDG(International Maritime Dangerous Goods) code reflected. The public is strictly prohibited to enter the warehouse without special acceptance. The warehouse is monitored by CCTV.

Production Practice 1.3: Inspect cyanide production facilities to ensure their integrity and prevent accidental releases.

	X in full compliance with	
The operation is	☐ in substantial compliance with	Production Practice 1.3
	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
The main facilities including reactor, tank, valve & pipeline were inspected periodically according to self inspection procedure. And also detail inspections were implemented by special inspection contractors every 5 years. The secondary containments and deterioration and leakage were checked and results were recorded daily by production team and safety team. Inspection frequency for reactor, tank etc. was defined from the decision of critical item control rule according to self inspection procedure and maintenance procedure. Inspection results including inspection date, inspector and deficiency were recorded. And also corrective actions for identified deficiency were implemented according to corrective action procedure.

2. WORKER SAFETY: Protect workers' health and safety from exposure to cyanide.

Production Practice 2.1: Develop and implement procedures to protect plant personnel from exposure to cyanide.

	X in full compliance with	
The operation is	☐ in substantial compliance with	Production Practice 2.1
	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
Since initial verification, TAEKWANG Ind. Co., Ltd. have established and implemented safety control procedure TACD-02014 and PPE control procedure TACD-02012 both were revised at 30 July 2009. TAEKWANG employee, visitor and contractor were protected from exposure of cyanide during normal, abnormal & emergency operation, maintenance and overhaul activities according to safety control procedure and PPE control procedure. And also each team develop & maintain work instructions for processes including raw material control, production, packing & shipping in those work instructions detail control & handling method of cyanide defined. They have developed & maintained work permit procedure for out-sourced repair & maintenance works. Training for precaution & handling of cyanide shall be implemented before repair & maintenance works and pre-action & PPE wearing are mandatory for workers according to work permit procedure.
They reviewed operational changes and modifications for their impacts on employee health and safety. Their employee participated safety committee to develop health and safety procedures. Working environment was inspected by sub contractor twice per year for such items as the concentration of hydrogen cyanide, dust & etc. The inspection results of sodium cyanide, etc. were usually "non-detected" comply with ICMC and legal requirement. They also used monitoring device to detect the leakage of hydrogen cyanide. The fixed monitoring equipment and portable detectors for hydrogen cyanide were calibrated every year. Employee, contractor & visitor shall wear clothing provided by TAEKWANG Ind. Co., Ltd. and exchanged when they are leaving cyanide process according to safety & health procedure. They identified areas and activities where workers can be exposed to cyanide and maintained warning signs of cyanide presence. Employee, visitor and contractor were required to wear PPE and prohibited from smoking, eating, drinking in those potential cyanide contamination areas such as process and packaging areas. They maintained buddy system for dangerous works as patrol, maintenance and repair works. And also during those works, employee and contractor use radio to request assistant for the case of emergency situation. Employee receives health check every year. And according to health check results, fitness of employee to perform their tasks were determined and follow up action implemented.

Production Practice 2.2: Develop and implement plans and procedures for rapid and effective response to cyanide exposure.

	X in full compliance with	
The operation is	☐ in substantial compliance with	Production Practice 2.2
	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:

TAEKWANG Ind. Co., Ltd. has developed and maintained self prevention plan in which detail emergency preparedness including cyanide exposure case were defined.
First aid equipment such as low pressure eye-wash station, air shower and fire extinguisher were maintained in process and packaging areas. First aid kits such as water, oxygen, resuscitator and antidote were maintained in cabinets installed in process area and office. Safety team inspected the first aid equipment & kits by monthly basis and replaced the equipment & kits not effective any more according to safety procedure. They maintained the MSDS, first aid procedure, emergency plan and cyanide handling method written in Korean in process and control room area. The storage tanks, containers and pipe line containing cyanide were identified by material name, MSDS and warning signal. And cyanide flow directions were identified by arrow mark in pipe line. They implemented control procedure for entrance and leaving from process area. According to that procedure, employee, contractor and visitor shall exchange clothing and pass the air shower before leaving the process. They employed nurse and maintained first aid kits and ambulance in plant. They nominated Good Morning Hospital in Ulsan city and informed about potential need to treat employee exposed to cyanide. The Good Morning Hospital understands TAEKWANG Ind. Co., Ltd.'s situation and nominated staff ready for emergency situation. Emergency plans of cyanide exposure cases were tested every year and the result and lesson were reflected revised plans. They established and maintained incident evaluation procedure in which detail investigation and evaluation for cyanide exposure incidents were defined. Since the initial verification during 2008 year, cyanide exposure incident has not been occurred in their plant.

3. MONITORING: Ensure that process controls are protective of the environment.

Production Practice 3.1: Conduct environmental monitoring to confirm that planned or unplanned releases of cyanide do not result in adverse impacts.

	X in full compliance with	
The operation is	☐ in substantial compliance with	Production Practice 3.1
	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
The control and treatment methods and routes for waste water, land contamination and air emission were almost same as initial verification during 2008 year. Waste water from was treated in in-house WWT and then discharged to Yongyeon WWT operated by Ulsan Metropolitan City. Monitoring results of final discharged water showed the cyanide concentration range was 0.04ppm to 0.2ppm during 2008 to 2010 year and comply with Code's requirement and Korea legal requirements. The discharged water is mixed and diluted in Yongyeon WWT, so the cyanide concentration is far below the 0.022mg/l. TAEKWANG Ind. Co., Ltd. do not need to monitor the free cyanide concentration in mixing zone, because the WWT is operated by Ulsan Metropolitan city. They do not have indirect discharge to surface water. Because all cyanide process were covered by dike and spilled cyanide, chemical & rain water were collected and dispatched to WWT. The capacity of secondary tank is enough to collect initial water poured into cyanide process area. In Ulsan city, there is no designated beneficial use of ground water, no regulatory point of compliance and no actual beneficial use of the ground water. So they do not monitor the quality of ground water. Only conduct the monitoring of land contamination to preserve land & soil. The result of recent test implemented during September 2008. The result was that the cyanide was not detected. They limited the hydrogen cyanide gas emissions maximum 4.7ppm according to Korean legal requirement to protect the health of employee and local community. Monitoring result of hydrogen cyanide concentration is 0.575ppm at December 2010 year. Monitoring frequency for air emission of hydrogen cyanide and water discharge was defined according to Korea legal requirements. With the analysis of monitoring results, They can identify the process change & incident and implement required corrective action.

4. TRAINING: Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Production Practice 4.1: Train employees to operate the plant in a manner that minimizes the potential for cyanide exposures and releases.

.....	**X in full compliance with**	
The operation is.	☐ in substantial compliance with	Production Practice 4.1
.	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
TAEKWANG Ind. Co., Ltd has established and implemented safety training procedure TACD-02004. They recruited those candidates who have been trained in the fields of chemistry and chemical engineering. Their training policy, procedure and program were established effectively to meet the legal requirements and international standards including this ICMC code. Based on the company training program and training needs of each personnel, training has been provided regularly to all workers. Training materials were prepared well and contained all information such as hazards of cyanide, MSDS, use of PPE and emergency preparedness. The trainings have been provided by manager and safety team members qualified according to training procedure. All operators, maintenance staffs affecting the risk of cyanide are qualified as required by company training & qualification procedure. Also, training effectiveness has been evaluated every six month by testing and observation. The evaluation results are reflected on training programs. In addition, all new employees prior to perform their job should be trained on safety and health for 16 hours at the time of joining the company and for 2 hours per month thereafter.

Production Practice 4.2: Train employees to respond to cyanide exposures and releases.

.....	**X in full compliance with**	
The operation is.	☐ in substantial compliance with	Production Practice 4.2
.	☐ not in compliance with	
.	☐ not subject to	

Summarize the basis for this Finding/Deficiencies Identified:
All employees are well aware of the emergency response actions against cyanide exposures and releases through repeated education, training and emergency drills. The emergency response plans specify all the employees' duties such as safety representative, first-aid responder or firemen, etc. Mock emergency drills are regularly conducted to ensure that the employees are familiar with their duties and roles. The results of the mock emergency drills are evaluated and analyzed. Any and all areas for improvement found are immediately improved. The results of education or training are recorded.

5. EMERGENCY RESPONSE: Protect communities and the environment through the development of emergency response strategies and capabilities.

Production Practice 5.1: Prepare detailed emergency response plans for potential cyanide releases.

..... **X in full compliance with**
The operation is. ☐ in substantial compliance with Production Practice 5.1
. ☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Five emergency response plans and scenarios for potential cyanide releases were developed effectively and revised to improve company's response capabilities. Detail methods to control the release at their source, containment, mitigation and future prevention including cyanide supply shut down, prevention of cyanide spread, collection of spilled cyanide & preventive action were defined in emergency procedure. The emergency plans and scenarios included all the necessary actions covering emergency communication, rescue, evacuation, relief, pollution prevention, assessment, communication among relevant institutions, etc. Job description as responsibility & authority were defined in emergency response plans and scenarios. Also, the plans describe use of cyanide antidotes and first aid measures for cyanide exposure. Production team and safety team conducted drills according to the emergency plan and scenarios. They review the result of each drill and update the emergency response scenario.

Production Practice 5.2: Involve site personnel and stakeholders in the planning process.

..... **X in full compliance with**
The operation is. ☐ in substantial compliance with Production Practice 5.2
. ☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
The emergency response plan deals with not only those factory workers assigned to their respective duties but also those concerned with the company. TAEKWANG Ind. Co., Ltd. prepared and established emergency communication channels to contact nearby factories at the chemical complex and potentially affected communities. Communities such as local government and environment authorities, fire stations, police and hospitals are included and they have communicated information of the risks related to the cyanide production, release and exposure. They engaged in regular consultation and communication with relevant stakeholders.

Production Practice 5.3: Designate appropriate personnel and commit necessary equipment and resources for emergency response.

..... **X in full compliance with**
The operation is. ☐ in substantial compliance with Production Practice 5.3
. ☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
All employees have been tasked with their respective duties to be performed during an emergency. TAEKWANG Ind. Co., Ltd. nominated safety team leader as primary emergency response coordinator, technical team leader as alternative emergency response coordinator and plant manager as total supervisor. In emergency response plan, the organization was consisted of communication team, personnel rescue team, excavation leading team and facility control team etc. Detail training such as personnel rescue, lead excavation, control of facility and etc. were required and provided to emergency responders. And also safety team tested the call-out response and feedback the results to responders. The equipment for emergency response actions is maintained in a ready state through regular check and repair. A list of such equipment is also maintained. Moreover, a cooperative system with outside entities has been established effectively. The outside entities are participated in the mock emergency drills. After the mock emergency drills, evaluation and review of effectiveness for emergency response plans were implemented.

Production Practice 5.4: Develop procedures for internal and external emergency notification and reporting.

..... **X in full compliance with**
The operation is. ☐ in substantial compliance with Production Practice 5.4
. ☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
The emergency communication channel, communication method and contact information were defined in emergency preparedness plan. In internal communication channel, the contact information as telephone number etc. for top management, plant manager, and each team leader and safety team members were identified. In external communication channel, regulatory agencies such as Ulsan Municipal Office, Korea Safety & Health Agency and labor office and outside response providers such as fire agency, nearby companies and Good Morning Hospital were identified. And through emergency simulation test, TAEKWANG Ind. Co., Ltd. identified potentially affected communities as nearby companies and plants. The communication methods and contact information such as telephone, mobile phone etc. for relevant personnel of outside responders and potentially affected communities were identified in emergency plan.

Production Practice 5.5: Incorporate into response plans and remediation measures monitoring elements that account for the additional hazards of using cyanide treatment chemicals.

..... **X in full compliance with**
The operation is. ☐ in substantial compliance with Production Practice 5.5
. ☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
TAEKWANG Ind., Co., Ltd. has established emergency preparedness plan and toxic chemical

neutralization plan. Detailed methodologies for remediation, neutralization, decontamination and control of contaminated material were defined in those plans. The plans defined that sodium hypochlorite, ferrous sulfate and hydrogen peroxide shall not be used to treat and neutralize the cyanide released into surface water. They also prepared the environmental monitoring for emergency release to identify the extent and effect of release, sampling methods, parameter and possible location in emergency plan.

Production Practice 5.6: Periodically evaluate response procedures and capabilities and revise them as needed.

	..... **X in full compliance with**	
The operation is.	☐ in substantial compliance with	Production Practice 5.6
.	☐ not in compliance with	

Summarize the basis for this Finding/Deficiencies Identified:
TAEKWANG Ind. Co., Ltd. conducted periodically emergency response exercise. And the plan & scenario reviewed and evaluated for their appropriateness and revised every year. The plan expressly stated that the results be evaluated, analyzed and used as data for improving of the plan and procedure. In addition, they implemented regular mock emergency communication training to check the state of the communication system. According to emergency procedure, emergency plan shall be evaluated it's appropriateness after the actual emergency cases and also the plan is revised as needed. Actual emergency situation requiring the plan has not been occurred since initial verification during 2008 year and the plant operation.