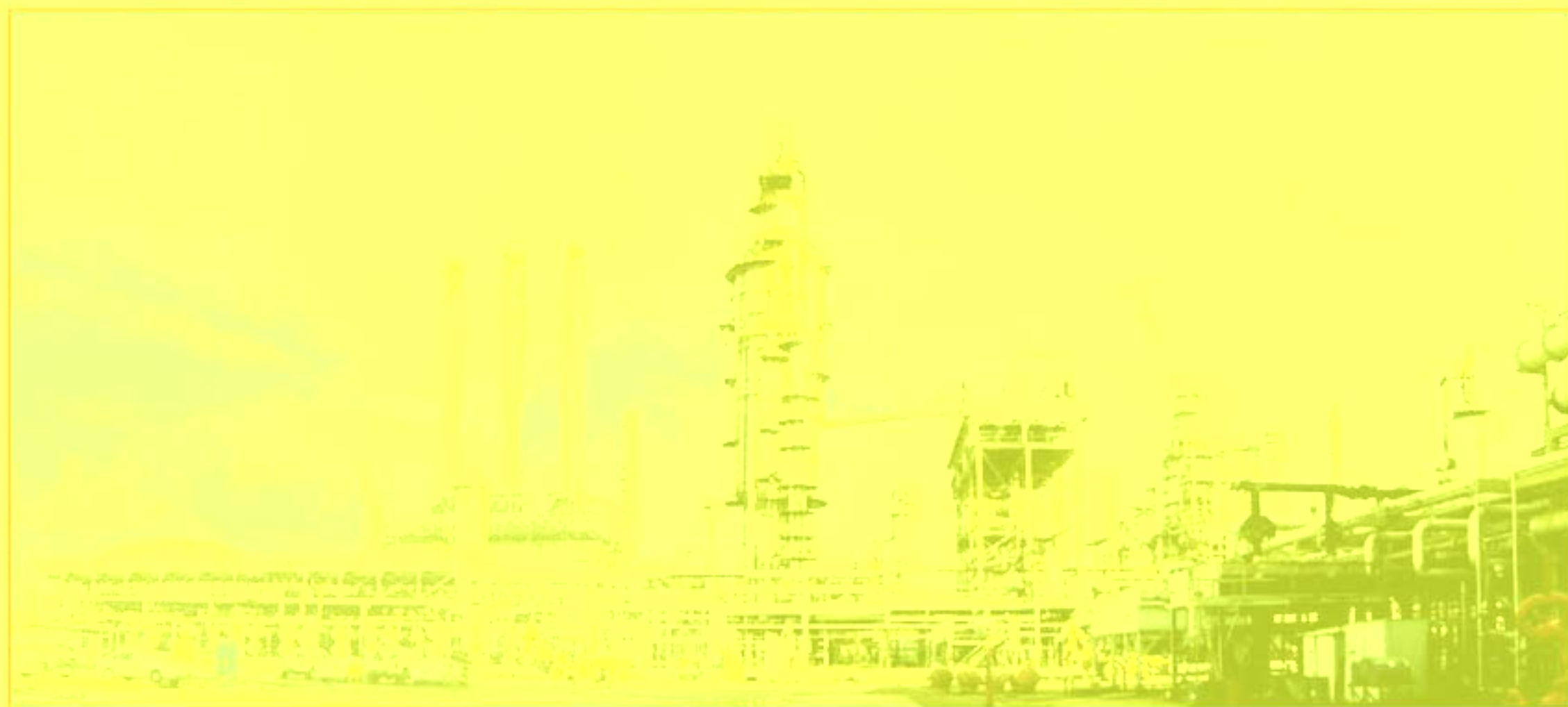


Risk Improvement Recommendations Update Report




Centro de Refinación Paraguana
Estado Falcón
Venezuela



Recommendations Update Visit Made: March 5th-8th 2012
Prepared on behalf of



Marine and Energy Syndicate 1036
Plantation Place
30 Fenchurch Street
London
EC3M 3BD

Prepared on behalf of  by Roger Gregory
4 Heath Villas
Plumstead
London SE18 1PG

Ref.2012/139

RJG Risk Engineering
Phone +44 (0) 77 03 73 11 16
e-mail rogeregkb@aol.com

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Cover Picture: PVAY-5 at Amuay.

This report follows visits to the PDVSA Centro de Refinación Paraguana, (CRP) made at the request of Underwriters, to assess and report on progress made in compliance with recommendations made by underwriters' risk engineers during their survey visits in 1993, 2002, 2005, 2007 & 2010. It also contains information on the reported operational status of the various units, significant operational events, significant maintenance/inspection events, details of any notable incidents or accidents reported to the risk engineers during the survey, and an update to the estimated maximum loss. For further factual information on key details of the risk, reference should be made to the Risk Engineering Report from the last full survey carried out on behalf of QBE in October 2010

The author retains drawings, photographs and other documentation, acquired whilst carrying out the survey, which can be made available should the need arise. All enquiries should in the first instance be directed to:

The Engineering Manager,
QBE Marine and Energy Syndicate 1036,
Plantation Place,
30 Fenchurch Street,
London, EC3M 3BD

Disclaimer

It should be noted that any liability which  Engineering may incur in tort (including but not limited to negligence) arising out of or in connection with this report shall be excluded absolutely.

It is acknowledged that this report is not intended to identify all hazards which may exist nor is it intended to be an exhaustive review of all possible eventualities. Any recommendations for risk improvement contained in the report are purely advisory and the decision and responsibility for implementation rests with the site's management. Responsibility for underwriting decisions rests with the underwriter in all cases. No responsibility can be taken for the accuracy of any information that has been provided by the client, (the assured, the broker or the underwriter) for the purposes of this report.

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Basic Information

CLIENT ORGANISATION	QBE Marine and Energy Syndicate 1036
COMPANY SURVEYED	Petróleos de Venezuela
LOCATION	Centro de Refinación Paraguaná (CRP) Amuay and Cardón Refineries These are essentially two refineries, operated as a combined system. Management, maintenance, etc are common to the two.
VISIT DATES	5 th to 8 th March 2012
VISIT LEAD BY:	Roger Gregory <i>RJGRisk</i> Engineering for QBE Marine & Energy Syndicate 1036
ALSO ATTENDED BY	David Dalla Costa (Chartis, Madrid, Europe),
PRINCIPAL COMPANY PARTICIPANTS	<p>Omar J Bravo CRP General Manager</p> <p>Jesús Malpica Technical</p> <p>Ronald Peña Seguridad Industrial</p> <p>Ramon Uzcategui Operations Management</p> <p>Eddie Miguilene PDV Maintenance</p> <p>Elisaul Moguslena SMC Management</p> <p>Carmelo López Process Management Amuay</p> <p>Ricardo J. Ramirez M. Process Engineer</p> <p>Rubén Boscán Manager Operations Cardón</p> <p>Zoilo Ronan Maintenance</p> <p>Luis Heredia Technical</p> <p>William Medina Finances</p> <p>Luis Guerra Operations</p> <p>Hector Martinez ISC</p> <p>Alberto Rodriguez SIHO</p> <p>Pedro Suarez GSA Cardón</p> <p>Felipe Semeco Operations SMA</p> <p>Fidel Fuenmayore Manager Routine Maintenance Amuay</p> <p>Francisco Montero Operations</p> <p>Nelly Rivero SIHO</p> <p>Ramon Cosi PCE</p> <p>Jose Vargas Technical</p> <p>Oscar Salazar Maintenance</p> <p>Angel Quintero Maintenance</p> <p>Denis Ruiz Technical</p> <p>Luisa Lugo Industrial Safety</p> <p>Juan Joé Ramirez Industrial Safety</p> <p>Alexes Bracho Q. PCE Operations</p> <p>Gernan Bustus Industrial Safety</p> <p>Javier Goitia Finances</p> <p>Maritza Vallejo PDVSA Corporate Insurance</p> <p>Sarah Claffey Cooper Gay, London</p> <p>Diana Renfigo Cooper Gay, Colombia</p> <p>Contributions were made by others during the presentations on recommendations and the brief site tour.</p>
	Roger Gregory <i>RJGRisk</i> Engineering on behalf of QBE Marine & Energy Syndicate 1036
SUPPLEMENTED BY:	Market Report by Roger Gregory <i>RJGRisk</i> Engineering on behalf of QBE Marine & Energy Syndicate 1036 from visit dated October 2010
PLANT ADDRESS:	Punto Fijo, Paraguaná, Estado Falcón, Venezuela
PLANT TYPE AND CAPACITY:	<p>Amuay: 635,000bopd, with distillation, lubricants, hydrotreatment, FCCU, HF alkylation, delayed coker and flexicoker (FCCU).</p> <p>Cardón: 305,000bopd, with distillation, lubes, hydrotreatment, FCCU, HF alkylation, isomerisation, delayed coker.</p>
LATITUDE, LONGITUDE, ELEVATION & AREA:	<p>Amuay: 11°37.8'N, 070°13.3'W, Elevation 5 to 20m amsl Area ≈ 380ha,</p> <p>Cardón: 11°45'N, 070°11.5'W, Elevation 5 to 20m amsl Area ≈ 420ha</p>
SITE SITUATION	Coastal sites, 14km apart, on south-west corner of Paraguaná peninsula, on the Golfo de Venezuela, Light population, no significant adjacent industrial exposures. Nearest town, Punto Fijo, approximately midway between the two sites.

2. Values and Estimated Maximum Loss

INSURED VALUES:	US\$x10 ⁶	Comments
Property damage	Cardón: 10,625. Amuay: 11,829.	From February 2010 valuations by Advanced Appraisals (Brazil). Increased by 1.5% for 2011. Includes equipment, construction, and Foundations. Very significant increases in values since the 2007 valuation by the same company (Cardón US\$ 4,843 millions, Amuay US\$ 5,843 millions). The recent valuations have been accompanied by a detailed site layout showing the location of each item.
Business Interruption		Not Covered
Boiler & Machinery Damage		Assumed included in Property Damage sums insured.
Contingent BI		Not Covered

 Loss Estimate:	US\$x10 ⁶	Comments
Property damage Amuay	3,356	HF Alkylation Isomerisation Section DIB column Overhead Receiver 100 tonnes.
Cardon	1,408	Cardón Alkylation 2 Isomerisation Section DIB column Overhead Receiver 100 tonnes. Similar estimate results from 37.1 tonne release in FCC Gas Plant.
BI from PD		Not Covered
MB	16	Major un-contained rotor failure of one of the three ex-"GENEVAPCA" gas turbo-alternators.
BI from MB		Not Covered

3. Summary

The main purpose of this visit was to obtain information on progress with respect to the risk improvement recommendations made during underwriters' risk engineering surveys in 1993, 2002, 2005, 2007 & 2010. In addition, we have included details of significant changes or events in management structure, in operations, projects, maintenance and inspection, details of reported incidents involving leaks, fires, or explosions, and an update of the estimated maximum loss based on any reported changes to insured replacement cost values.

At the commencement of the survey there were 22 outstanding recommendations comprised of a total of 46 uncompleted action items, and of these items we are able to report 16 (35%) closed, 19 (41%) in progress, and 11 (24%) with no progress.

Reference should be made to the October 2010 underwriting report for further details of the risk. Only changes and events of significance in are recorded in the descriptive body of the report. In particular, details of values and the development of the Estimated Maximum Loss are unchanged, with the exception of a small "indexed" adjustment to values advised by the client.

Overall, we see some positive progress, although we continue to rate this large refinery complex as "in need of improvement" as in 2010. A stronger "proactive" approach is necessary in our opinion.

The **overall company structure** for Refining is essentially unchanged. A new Maintenance Organisation "Planificación y Dirección Venezolana de Mantenimiento" has been set up to streamline the planning and execution of major maintenance at the PDVSA facilities. This is based at Paraguana.

Production at the time of our visit was 500,000b/d at Amuay (nameplate 635,000b/d), with all units operating except the Flexicracker (FCCU), Alkylation, Depentaniser, Isomerisation and one Sulphur Recovery train. There are throughput limitations on Crude Unit 1 vacuum feed furnace. Cardón is operating at 195,000b/d (nameplate 305,000b/d), with the largest Crude Unit CD-4 and associated vacuum unit shut down following the February 5th fire on CD4, these should re-start very shortly. Sulphur Unit PRA-3 is shut down. Jetty 1 is in repair following the October 2010 fire.

Major maintenance (turnarounds) has been seen to be suffering from delays, typically of one or two years, supported by "Technical Operational Evaluations". These large refineries, with a multiplicity of units have many should give operational flexibility to take units out for maintenance. It is hoped that the new "PDV Mantenimiento" will reverse the trend of delays to major maintenance.

Routine maintenance suffered a significant "low" in 2009, the effects of which are still being felt, evidenced by a marked increase in the ratio of corrective to preventive maintenance. The effects are also evident in the maintenance backlog particularly for pumps and motors, and in a higher than target proportion of "Emergency" and Urgent" work orders. However, it is encouraging that these figures are being reported to management. Procurement remains a significant challenge, although proprietary pump seals are available.

There is a continuing effort on the **structural integrity programme**, with good evidence of progress, however it is recognised that the scale of the problem on these "aging assets" remains a high priority. This includes the ferroconcrete structures, steel structures and their passive fireproofing. It is noted that many units yet to be treated are making use of temporary support structures, and that these are not fireproofed. It is also noted that the work of temporary construction and replacement is carried out as "SIMOPs" (i.e. simultaneous structural work on an operating unit).

Inspection remains organised as before, but with some additional own-hire staff. On stream inspection is by a local contractor (Inspfalca) who also provides scaffolding etc. Analysis remains by PDVSA staff, and "SILCO" is used for scheduling, recording and analysis. A Corrosion Under Insulation plan has been commenced, producing manuals of CUI prone areas and inspection plans. There have been verticality and thermographic inspections of furnace stacks, and this programme is actually running ahead of schedule. Off-Process (Outside Battery Limit) pipework has now been included in "SILCO". Storage tanks are inspected on "Risk Based" criteria, tanks prioritised, and inspections being carried out on "High" and "Very High" risk tanks first. Typically 26 tanks per year at Amuay and 34 per year at Cardón are to be inspected – this is intended – in time – to eliminate the present substantial back-log. Pressure vessel inspections are said to be fully up-to-date, and included in "SILCO".

Pipework inspection records were viewed for the Amuay PVAY-4 Vacuum Column Overhead circuit and Bottoms lines. These were easily found, and the inspection records were available back to 1986. We were concerned however that no baseline inspection had been carried out following a significant replacement and change of steel alloy, that the maximum 2 year cycle had not always been kept to, and that for the overhead circuit, where there was known significant thinning of the pipe wall to the extent that remaining useful life was short and a "special watch" had been specified, there was no attempt to check any of the many "dormant" TML zones.

Technical Services continue to be involved in projects, monitoring of process “excursions” etc, and there is a major Alarm Management exercise underway, to address the known problem of alarm “overload”. This project, in our opinion, requires more formality.

Safety (SIHO) continues to audit permits to work and to carry out detailed audits, and report improvements in some areas of compliance. There has been increased training of issuers and receivers of permits and other topics including housekeeping. The “SISA” database is used to progress recommendations, and although there remains a large number of open items, it is reported that this has been reducing. There is a “Dupont” inspired “manual of lessons from past events, with “Best Practice” exemplars as well as analyses of incidents. Includes process associated events, PTW, LoTo, etc.

Fire Protection: Organisation unchanged, firefighting equipment now being added to “SAP” maintenance scheduling. Many new fire trucks have been received, and old ones are being refurbished where economic. Fire pumps still do not comply with annual curve testing, and recent tests show two of the diesels at Cardón, although operating, have deficiencies. There is a corporate initiative for the inspection and maintenance of firefighting and detection apparatus. (SICOINE database). When fully populated, this will replace the present paper system, which is being operated in parallel

Security: has been moved from Operations to the Safety and Protection group, and there are investments in progress to automate the access control system, the inter-site communications, to improve perimeter lighting and to build the National guard a new “Reaction Centre”.

Incidents: During 2011 there were 222 incidents reported, including some 100 fires, many of these being in contaminated pipe trenches. Although there is a good procedure for incident investigation, we were disappointed to not that few had progressed past the stage of setting up a study committee, and only 9 were “closed”, with recommendations carried out. Specific incidents since our 2010 visit described to us were:

- 11/09/2010 Cardón Jetty 1 fire – Burst Kerosene Loading Hose.
- 15/03/2011 Amuay HDAY-4 86,000b/d Gasoil Hydrotreater Explosion – CUI on Hydrogen line
- 24/05/2011 Cardón 77,000b/d FCC Furnace Explosion – Explosion during re-start following instrument air loss.
- 06/06/2011 Amuay HYAY-2 9.5mmscf/d Hydrogen Plant (Reformer) Furnace F-851 Explosion – “Plugged” tubes, not dried out, exploded and ruptured adjacent tubes.
- 06/01/2012 Cardon Platformer “Incipient” fire – radiant area leak following significant overtemperature.
- 09/01/2012 Amuay PVAY 27,300b/d Vacuum Unit Unsafe Condition of Furnace F-100 – Collapsed refractory and carcase distortion
- 05/02/2012 Cardon CDU4 70,000 b/d Crude Distillation Unit Fire – failure of small bore line on atmos. Column bottoms pump suction.

There have been several furnace incidents in the past few years, but there is no apparent common cause.

4. Company Administrative Structure Changes

The company structure as applies to refining is essentially unchanged.

There is a new group "PDV Mantenimiento", (Planificación y Dirección Venezuelana de Mantenimiento) intended to have a national scope, to address the challenges of major maintenance in the Oil, Gas and Petrochemicals activities of PDVSA and by extension, others in similar fields. (See "Maintenance" below)

A "Strategic Reserve" of about 50 engineers representing all disciplines, (especially electrical and plant) has been formed, on a two year training cycle, and these are currently working under supervision.

There was a rump of retirements in 2010, retirement can be at age 60, but can extend to 65. and there are typically now 20 to 25 retirements pre year on an overall staffing level of 4360 (direct hired). This includes the power & steam generation facility "Genevapca" which was absorbed into the company structure, but does not include the marine operations or the "Bariven" staff seconded to CRP.

5. Operational Status and Significant Events

Present operational status is as follows:

Amuay is running 500kb/d crude rate (design is 635kb/d), with no change to the crude diet. Units are all operational with the exception of the Flexicracker (FCCU DCAY), the Alkylation unit (ALAY) and Depentanser (DPAY), Isomerisation (ISAY) Light Ends Recovery (GLAY) on maintenance since 21st January, with a planned oil-in date of 15th April. The only changes have been reliability improvements to large rotating machines, no changes to processes or technologies. Kerosene Hydrotreater (HDAY-1) was shut down last week to decoke the catalyst beds; Sulphur Recovery 3 (SUAY-3) is not operating. Crude Distillation Unit PSAY-1 had a tube failure in the F3 Vacuum Feed furnace, limiting capacity to 55kb/d (design 63kb/d). Furnace planned to be replace during March 2012.

Cardon is operating at a maximum of 195kb/d crude rate (design is 305kb/d), with the largest distillation unit CD-4 shut down due to the February 5th 2012 release and fire (see "Incidents" below). In consequence, Vacuum unit AV-2 shut down. These should re-start during March 2012. The Platformer/Hydrotreater developed a furnace F301 tube leak and was shut down 6th January, re-started 12th January. The FCCU suffered a "Steam valve" event 20th February, and was shut down for 3-4 days. Alkylation unit 1 had been shut down for more than a year, and restarted end of January. The Feed/Product heat exchanger M 1001 has an internal leak, although this is reported not to be affecting production rate or quality. Sulphur recovery unit PRA -3 is not operational. Repairs to Jetty 1, which suffered a serious fire in October 2010 (See "Incidents" below) is planned to be completed to allow operation to resume by the end of August 2012.

6. Maintenance Status and Significant Events

The principal change to the maintenance organisation has been the separation of Major Maintenance to be the responsibility of a filial group "PDV Mantenimiento" (see below). Operational maintenance remains within the CRP organisation.

There are 8 groups reporting to the manager of maintenance at CRP - Planning & Contracts, Workshops, Routine Maintenance Cardón, Routine Maintenance Amuay, Instrumentation and Control, Special Equipment, Materials (stores), and Assistance / Management. Electrical Maintenance is located in the Operations Department, with the exception of Electric Motor maintenance, which has its own workshop in Maintenance Department.

The total number of workers in the CRP maintenance organisation as at January 2012 was 1139. We do not have figures for vacancies.

The maintenance philosophy is essentially unchanged, Preventive – calendar or condition based, Corrective for failures, maintenance projects to optimise performance or eliminate root causes of failures, all within CRP maintenance, and "major maintenance" now with PDV Mantenimiento.

"PDV Mantenimiento", (Planificación y Dirección Venezuelana de Mantenimiento) is a specialist maintenance group headed by Sr. Jesus Luongo, head of Refining Group, and as such comes under the overall management of CRP. The decision to form this group was taken late in 2010, in response to concerns about delays to and costs of major maintenance to the PDVSA assets. Presently there is a staff of 134 engineers and administrators, with a plan to increase eventually the head count to 800 or more. The motivation is to create and preserve expertise in the planning, contracting and execution of major maintenance activities such as Turn-Around Maintenance, and the provision of a stock of necessary tools and accessories (cranes, welding sets, scaffolding etc. – investment in this areas stated to be in the order of US\$ 25 millions). The group is run by a board level "Junta Directiva", and reporting to this are departments for Administration, Planning, Operations (i.e. responsible for execution of major maintenance work on Plant and Equipment, not plant operation), Technical, (who are responsible for standards, compliance, engineering technical disciplines), Contracts (to manage third party works), Finances, Services & Logistics.

The scope and timing of major maintenance activities will remain with the individual refineries and operational groups, and hence "PDV Mantenimiento" will act very much as an internal contractor. In time it will have branches at all PDVSA main sites. Note that "PDV" in the title is "Planificación y Dirección Velezuelana" and not "Petroleos de Venezuela", and that the long term aim is for the organisation to be available for other industries in addition the oil, gas and petrochemicals sector. To put the Major Maintenance challenge at CRP into perspective, there are some 83 process units in the Cardón – Amuay refineries, plus offsites and utilities, and jetties. In a typical year, there are about 37 major maintenance interventions (turn-arounds), and this may rise to a peak of 54 in some years.

The contract award process is still essentially as before though, with a need to comply with the laws of Venezuela, and "Bariven" are still to be used for procurement.

It is understood that "MG3P" software is to be employed for the planning and management of turn-arounds, to control the oil-out to oil-in duration and to keep within the maintenance objectives.

Key Maintenance Performance Indicators are presented annually to management in a "Rendición de Cuentas". The following are extracted from recent "Rendiciones".

Major maintenance (Turnarounds) costs since 2008 have been:

Type	2008	2009	2010	2011
Partial Turnarounds	26	27	12	12
General Turnarounds	2	12	6	3
Cost (US\$ Millions)	477.85	388.66	432.91	314.30

The emphasis in 2011 has been Amuay, with Sulphur Recovery SUAY-2 & 3, Acid Gas Recovery FMAY-1, Sour Water Treatment SWAY-2 & 4, Gasoil Hydrotreater HDAY4, Reformer HYAY-1, TSAY, and Jetty 2 at Amuay, plus Sep Tap 3, Separator 1, the CCR Platformer and the Jetty 1 repairs at Cardón.

The original plan for 2011 was stated to be for 27 General Turnarounds and 2 Partial Turnarounds. The original budget for 2011 was reported to be in excess of US\$ 1 billion.

Overall, compliance with the declared turnaround intervals for the various plants has been variable, with plants set at 4 years being run from 2006 to 2011. Many of the units that were scheduled for turnaround in 2011 have been postponed into 2012, with subsequent increases in run length, following a "Technical Operational Evaluation". This evaluation focuses on operational issues with the most critical equipment, mostly concerned with Dynamic rather than Static items. A few examples of postponements are given below.

Site	Unit	Description	TAM Int yrs	Last TAM	Planned TAM	Postponed TAM
Cardón	CD-3/AV-3	Crude & Vacuum Units	5	July 2006	June 2011	Apr 2012
Cardón	HDT-1	Gasoil Hydrotreater	4	Aug 2007	July 2011	July 2012
Amuay	ALAY	Alkylation	4	Oct 2006	Sept 2011	Feb 2012
Amuay	DCAY	Cat Cracker (Flexicracker)	4	Oct 2006	Sept 2011	Jan 2012
Amuay	HDAY2	Distillates Hydrotreater	4	Apr 2007	May 2011	2013

Major maintenance to the jetties at Amuay has been significantly later than the 8 year interval specified, with Jetty 2 having had its turnarounds in 1998 and 2011. Jetty 4 at Cardón had its last turnaround in 2000, and has the next planned for late 2012. For Jetty 2, the last turnaround was in 2006, and the next will be planned for 2014 to 2016, although it is having replacements and upgrades to some of its fire-fighting mains and apparatus.

The costs for routine maintenance since 2008 have been:

Type	2008	2009	2010	2011
Corrective	94.298	66.950	97.802	193.644
Preventive	116.398	49.962	71.456	95.551
Mixed	13.830	2.105	2.470	1.021
Totals : US\$ Millions	224.526	119.017	171.727	290.215

Prior to 2009, the costs were relatively steady in the range US\$ 220 to 280 millions.

From this data, measured on a cost basis, the proportion of "Corrective" maintenance is clearly increasing, from about 50% up to 2009 to 67% in 2011. On a Work Order basis, the proportion is 69% Corrective to 31% Preventive. It is instructive to note that the low maintenance spend in 2009 has been followed by a marked deterioration in the corrective/Preventive ratio. The target figures often stated in PDVSA are 20% Corrective to 80% Preventive.

Compliance with maintenance programmes and backlog for the whole of CRP is summarised below:

Type	2008	2009	2010	2011
Compliance: Preventive: Pumps and Blowers Target >90%	92.1	88	91.5	87
Compliance: Preventive: Special (Turbomachinery) Target >95% (was 85%)	83.3	66	56	86
Compliance: Preventive: Instruments Target >98%	98.22	96.12	95.13	95.3
Compliance: Predictive: Pumps Target >90%	90.6	80.8	74.1	Unavailable
Backlog Pumps in Workshop (Nos) Average Target <125	109	111	179	252
Backlog Motors in Workshop (Nos) Average Target <75	55	55	88	127
Backlog Exchangers (Nos) Average Target <20	27	21	31	8
Compliance with Weekly Plan Target >85% (man-hour based)	83	83.5	85	81
Work Orders by Priority (Emergency/Urgent/Routine) Target <5-<15->80	3-10-87	5-9-86	9.5-15.5-75	9-25-66
Compliance Maintenance Prog. Major Equipment (%) Target 85%	62	51	57	Unavailable

The principal reasons given for the worsening performance with respect to pumps and motors was insufficient resources, difficulties in placing and continuing contracts, and the procurement of spare parts. During 2011, the contract workforce accounted for some 3 million man-hours of work, implying an average contract workforce in the order of 1,500 for routine maintenance activities.

Spares procurement lead time for National purchases are typically average 30 weeks, whereas international purchases average over 60 weeks. The operational inventory of spare parts is in the order of US\$ 45 millions.

The most critical spares in this instance are typically seals, reducing gears, and bearings. For pump seals, which are critical to the integrity of containment systems, there are technical support and supply contracts with proprietary seal manufacturers, organised through "Bariven" the PDVSA procurement organisation. The supplier (John Crane) has a base at CRP as a first point of contact, and as a fall back Bariven will deal with John Crane USA.

Overall, there is closer compliance with the routine maintenance programme at Cardón Refinery than at Amuay. Instrumentation is interesting however, in that a lower number of "operational doubts" are being recorded, that is, where an operator queries the correctness of an instrument reading, and the instrument artificer called to check the instrument finds "no fault" in the instrument. Operators have been trained to recognise problems, and confidence in the instruments on the part of operators is therefore seen to be growing.

There has been significant work on remediation of the structures both at Amuay and Cardón. This has included replacement of steel and ferroconcrete structures, and the remediation of detached fireproofing on steel structures. Temporary supports that had been introduced as emergency measures have generally been left in place, and are redundant, although they are likely to be removed for use elsewhere on the refinery. We note that whilst the temporary structures were in place, they were not fireproofed. At Cardón, work is completed on the Furfural Extraction Unit, Vacuum Distillation 1, Vacuum Distillation 3, FCCU, and Asphalt Blower, in progress on the Propane De-Asphalter 1, and Crude Distillation 3, planned to start October this year on the FCCU Fractionation pumphouse and auxiliary pumphouse, the pipeway bridges, and Jetty 4 in March 2013. Significant other repairs are planned in 2012 for the Hydrotreaters, MEK De-Wax unit, Crude Distillation 1 and Alkylation 2. At Amuay, work has progressed on PSAY-3 crude unit, PVAY-3 Vacuum unit, PVAY-5 Vacuum Unit, NFAY-5 Naphtha Fractionator, PS/PVAY-1 Crude/Vacuum unit, HDAY-4 Kero Hydrotreater, and work is planned for the DCAY Flexicracker.

We note however that much of this work is carried out as a "SIMOPS" activity

7. Inspection Status and Significant Events

There is no change to the organisation of Inspection. Establishment staffing is 46, and there are 40 in post. A "Strategic Reserve" of 5 has been recruited and should commence here soon, plus a further 2 as Corrosion and Materials specialists. The Strategic Reserve is sourced from new graduates, or people recruited from recognised contractors.

The Inspection scheduling and analysis tool used is "SILCO" and contractors (Inspfalca) carry out the field ultrasonic measurements, the contract includes the measurements and the scaffolding required to do access the measurement points. The contract is on a 2 year cycle, due to expire May this year, and CRP is in the process of negotiating the new contract which (hopefully) will be in place before the expiry of the old contract. Analysis of the readings is carried out by PDVSA staff.

- A Corrosion Under Insulation (CUI) plan was commenced in October 2011. The aim is to produce a CUI Manual specific to each unit on the refinery, and there are 5 phases to the work:
1. Technical Concepts (reference codes: API 571, NACE International, Shell DEP 30.46.00.31 y PDVSA PI-02-09-04)
 2. Identification and classification of thermally insulated lines
 3. Development of Isometric Drawings of High Consequence lines (function of pressure, temperature and material contained)
 4. Data Collection
 5. Consolidation of information and identification of inspection facilities.

The plan is to complete all the manuals by the end of May 2013. To date, progress achieved is 14% against a plan of 27%. The manuals specific to the Furfural Extraction and MEK Dewax units (Lubricants) are reported to be complete, and a plan has been developed and executed (clamps added) for the three Hydrotreaters following the March 2011 HDAY-4 incident (see "Notable Incidents" below)
(Note, the HDAY4 CUI incident was in March 2011).

There has been a programme of visual, "verticality" and thermographic inspections of the chimneys of the various furnaces and fired heaters on the refinery. There are approximately 35 furnaces at Cardón and 50 at Amuay. Inspections cover the carcass of the chimneys and their ducting, refractory linings where fitted, painting, guys and other external supports, and produce comprehensive tabular database reports. (example below) The plan, phased over two years commenced November 2011, and is running significantly ahead of schedule currently (40% versus 15% planned).

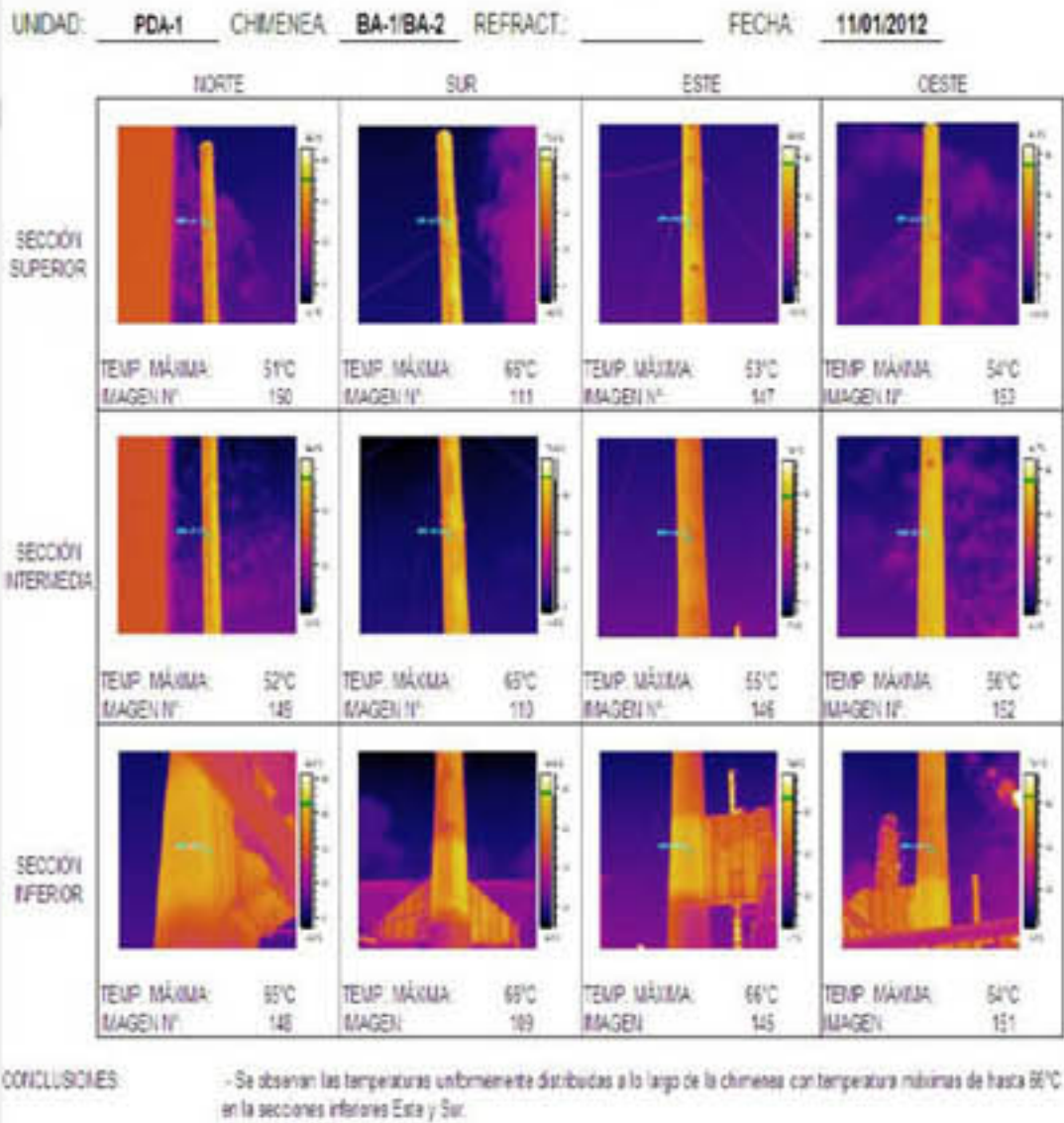


RESULTADO DE INSPECCIÓN VISUAL DE CHIMENEAS

I PARTE: RESUMEN DE DATA TECNICA							
REFINERIA	CARDON	COMPLEJO	DESTILACION & LUBRICANTES	PLANTA	FEU		
EQUIPO ASOCIADO	BA-2 A/B	TAG	NA	FECHA DE CONSTRUCCION (AÑO)	1951	FRECUENCIA DE EVALUACIÓN	UN (01) AÑO
DIAMETRO PREDOMINANTE (MTS)	1,8	ALTURA (MTS)	45,72	MATERIAL DE PARED	A-36	ESPESOR DE PARED (MM)	9,53
TIPO DE PARED	FRIA	TIPO DE AISLANTE TERMICO	Moldesite Semisilante tipo Unifano Extraliente LI de 3" de espesor de Cerámica Carbobo (equivalente en resaca "kasi-o-lita" 25 GR-V o en Refractorios del Caroni I.R.C 26 LI) para una temperatura máxima de operación continua de 1100°C.	ESPESOR DE AISLANTE TERMICO (PULG)	3	FECHA DE EVALUACIÓN ACTUAL	21/01/2012
II PARTE: RESULTADOS DE CONDICIONES OBSERVADAS							
RESULTADO DE INSPECCIÓN VISUAL EXTERNA DE LAS PAREDES	1... Las paredes presentan corrosión generalizada leve. 2... No se observaron daños ni deformaciones aparentes en el ángulo de refuerzo superior. NOTA: No se observaron agrietamientos y desprendimientos en la base de concreto.						
CONDICIÓN DE PINTURA Y RECUBRIMIENTOS PROTECTORES	Se observó desprendimiento leve de la pintura en todo el cuerpo de la chimenea y corrosión generalizada en la misma con prevalencia hacia el lado oeste.						



PLAN DE TERMOGRAFÍAS DE CHIMENEAS CRP/ CARDÓN
ARCHIVO DE IMÁGENES ENERO 2012



Outside Battery Limit Pipework between units and storage within the Amuay and Cardón sites, and serving the jetties have been included in the "SILCO®" scheduling, recording and analysis tool. It is reported that all lines have now been included. The lines between the refineries are surveyed by Security for interference or incursion.

- Low Pressure Storage Tanks are inspected on a "Risk Based" approach. There are 6 phases:
- External evaluation,
Visual inspection and historical review
 - Repairs database
Actualisation and development of existing database, creation of dynamic tables
 - Failure Consequence Analysis
Based on characteristics of storage, material stored, safety and operational factors
 - Failure Probability Analysis
Corrosion & Operational History, location & design.

TANQUES POR AÑO	CRP		
PLAN DE MITO	AMUAY	CARDON	Total general
AÑO 2012	26	34	60
AÑO 2013	25	33	58
AÑO 2014	25	33	58
AÑO 2015	25	33	58
AÑO 2016	12	33	45
AÑO 2017	20	33	53
AÑO 2018	14	33	47
AÑO 2019	23	33	56
AÑO 2020	8	13	21
AÑO 2021	23	20	43
AÑO 2022	6	8	14
AÑO 2023	9	8	17
AÑO 2024	10	12	22
AÑO 2025	6	3	9
AÑO 2026	3	11	14
AÑO 2027		7	7
(vacías)	62	74	136
Total general	297	421	718



- Analyse Risk Level
failure probability and consequence considered. 5 x 5 matrix, risks classified in 5 grades from "Very Low" to Very High
- Develop maintenance plans for next 15 years See table above.

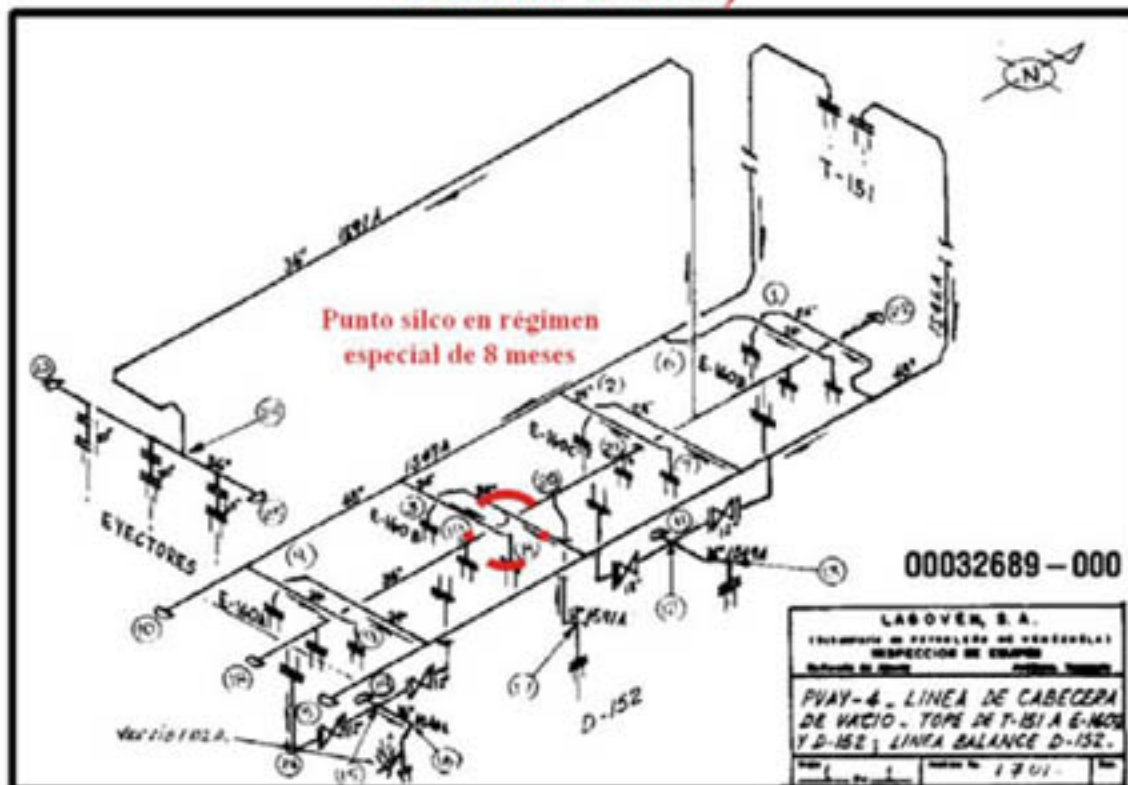
The Risk Basis determines the priority of tanks to be addressed, and initially the majority will be the "High" and "Very High" risk tanks. There is no apparent equivalence to the ~250 tanks overdue for inspection/maintenance reported in 2010. There remains however significant operational pressure on the availability of these tanks for inspection and maintenance, and only time will tell if this initiative succeeds. A similar philosophy is applied to the pressure storage spheres and bullets.

There is reported to have been 100% compliance with **Pressure Vessel Inspections** (drums, exchangers, columns/towers and reactors), with a total of 1719 at Amuay and 1353 at Cardón inspected in 2011. These are also scheduled and recorded using the "SILCO®" software.

As a sample, we requested to see the inspection records of the Amuay PVAY-4 Vacuum Distillation Unit T-151 column Bottoms line, through to the bottoms pumps. We were informed that in 2007 this had been changed from carbon steel to 5% Cr Low Alloy carbon steel during a routine planned turn-around. No base-line wall thickness measurements had been taken. First measurement was in March 2011, and at that time 2 measurement points (multiple TMLs) were recorded. Reason given was that it was a costly exercise, and because an alloy steel had been used, the inspections were not necessary. Inspections at 2 year intervals are reported to be required for this duty, and this has not been complied with. Next turnaround is in 2013.

A second line requested was the overhead line for the same vessel. This is a negative pressure line, and is fitted with stiffening hoops and support clamps. Initially there were about 20 inspection points, but these had been reduced to 5 based on operational and corrosion experience. The other points, presently "Inactive" in "SILCO®" do however have some historic readings, and could be reactivated. Point 8, an elbow, had been measured in 1986, 88, 91, 93, 95, 98, 2000, 01, 04, 08 and twice in 2011. The graph presented shows little loss in wall thickness up to 1998, then a significant loss in the period 1998 to 2000, followed by a continued slow reduction. The remaining life for the five points measured varied from a maximum of 15 years, to a minimum of 1.6 years (for Point 8), and it's inspection interval has been reduced to 8 months. We would question whether this finding should have justified the reactivation of "inactive" inspection points on this circuit? (See illustrations below) These and other lines are due for replacement in the 2013 turn-around.

LINEA DE CABECERA DE VACIO (TOPE DE LA T-151)



ULTIMA INSPECCIÓN

Planta:	PVAY4	Circuito:	1701A	Punto:	8	No. Insp.:	12
Palpador	Temp. Med	Inspector	Receptor	Fitting	Fecha Medida		
150	100 °F	RADIO2	PINEDAAT	F01	14/12/2011		

A1:	0.198 "	B1:	0.208 "	C1:	0.223 "	D1:	0.234 "
A2:	0.200 "	B2:	0.208 "	C2:	0.232 "	D2:	0.229 "
A3:	0.201 "	B3:	0.219 "	C3:	0.229 "	D3:	0.188 "
A4:	0.215 "	B4:	0.203 "	C4:	0.224 "	D4:	0.183 "
A5:	0.000 "	B5:	0.000 "	C5:	0.000 "	D5:	0.000 "

Planta	Circuito	Punto	Fecha Punto	Condición Punto	No. Reg.	Régimen	Frec Insp
PVAY4	1701A	8	17/05/1986	Activo	4	Nor	8

ULTIMA INSPECCIÓN

Planta	Circuito	Punto	Inspección	Rég. Punto
PVAY4	1701A	8	12	<input type="radio"/> Nor <input checked="" type="radio"/> Esp

Fec. Prox. Asignada:	08/11/2012	Fec. Prox. Calculada:	08/11/2012
Pos. Act.:	B4	Esp. Act.:	0.203 "
Pos. Min.:	A2	Esp. Min.:	0.177 "
Recp. Act.:	0.045 "	Recp. Activo:	0.004 "
Recp. Min.:	0.000 "	Recp. Min.:	0.004 "
V.U. Act.:	01.6 Años	V.U. Min.:	12.9 Años

Esp. Min: 0.183
Esp. Max: 0.234
Esp. Nom: 0.375
Esp. Ret: 0.125

Fre Insp: Cada 8 meses
Pr Oper: -13.7 PSI
Corr. Prom: 0.008"
V.U Act: 1.6 años

V.U = "Vida Util" (Useful Life)

8. Technical Services

Technical Services continue to monitor processes, process variables' deviations and excursions, feedstock changes in quality etc, consultation on maintenance planning. There is a major project on the Lubricants units, involving an expansion and adding emergency isolation valves etc. The drawings used for the expansion are still the "Maraven" drawings from 1994, styled as "for detailed design". However, engineers walk the plant and confirm that the relevant parts of the plant are realistically represented on the drawings. Technical are involved in the "HazOp" and "What If" studies and the "Diadem PHAPRO" format is used for these.

Process Variables are monitored to initiate action or analysis when significant deviations in temperature, pressure, composition, pH, Chlorine, iron content etc. take place. Fuel gas is analysed by a gas chromatograph, and the Lean Amine specification is 100ppm total Sulphur. There is presently no problem with amine supply. Any shortfall is said to be countered by reductions in rate. There has been a change in the supply of Natural gas for the reformer and turboalternators, and although this was not carried out under the management of change regime, an equivalent procedure is said to have been used.

There has been an **Alarm Management** exercise, so far on crude unit CD-4 in accordance with EEMUA 191-1999 and ANSI/ISA 18.2-2009. Honeywell Event Analysis is being used. The classifications, in ascending order of criticality are:

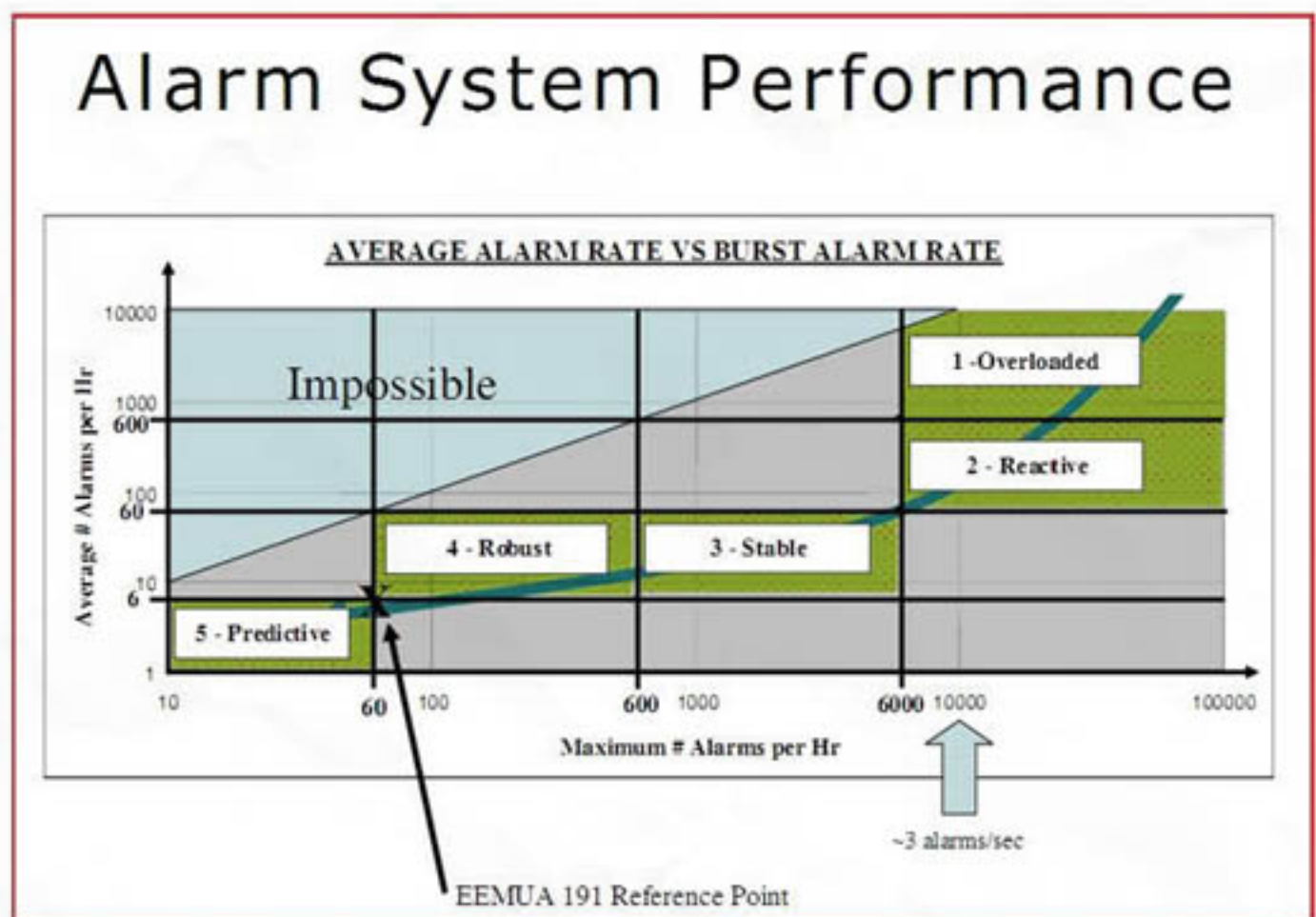
- "Predictive" (average ≤ 6 , maximum ≤ 60 alarms per hour),
- "Robust" (average ≤ 60 , maximum ≤ 600 alarms per hour),
- "Stable" (average ≤ 60 , maximum ≤ 6000 alarms per hour),
- "Reactive" (average ≤ 600 , maximum ≤ 6000 alarms per hour)
- "Overloaded", which is anywhere more than "Reactive". (see diagram from EEMUA 191, 2nd edition).

Other criteria in the guidance include the number and duration of "shelved" and "Standing" alarms, and the "Top 10 Load Percentage".

Using these criteria, it has been recognised that most systems are "Overloaded" according to the EEMUA definitions, and have been so since 2008. Some action to rationalise the alarm systems has taken place, but not to the EEMUA philosophy, and with no specific budget. To a large extent the success of the present initiative depends on the accuracy of the P&IDs, although the software in the Honeywell systems can be used to define the alarm loops for analysis. It is instructive to note that the alarm management study was initiated. At least in part, as a response to the May 2011 Cardón Fluidised Catalytic Cracker furnace explosion.

In our opinion, the Alarm Management Programme requires to be formalised and adequately funded.

There is a plan to install two "Polyductos" (multi-product batching pipelines) 10"Ø and 16"Ø to supply proproducts to the Bajo Grande distribution centre near Maracaibo.



9. Safety, Fire Protection & Security

The organisation for the Industrial Safety/Health/Environment (SIHO), Security (PCP) and Fire Intervention has had a small change, with Security being moved in from Operations. Overall staff establishment for SIHO and PCP is 83, and a further 15 posts await approval. Safety has an establishment of 17, 3 vacancies being currently filled by contractors, and additional safety analysts plus occupational hygienists are being recruited (part of the 15 above). The Firefighters have an establishment of 64, with vacancies for 2 supervisors and 32 firemen.

Safety

The "SISA" database for recommendations arising from audits, investigations or safety reports by others (including the Insurers' recommendations) continues in use. In all, since its inception in 2004, there have been some 4,600 entries, roughly evenly distributed between Amuay & Cardón. On the database, these are recorded as "CU" (completed), "EP" (in progress), "CA" (cancelled), "SF" (long term), "NA" (Pending Response) or "SS" (selected for audit of completion). There are reported to be 621 of these in categories other than "Completed", and the number remaining to be completed is said to be on a reducing trend.

There continue to be single topic audits on the units and audits of Permits-to-work. The aim is to have 3 or 4 audits per area per year – and with the increased number of Safety Analysts, this should become achievable. Detail audits can take between 1 and 4 days, depending on the complexity of the area under study. In particular, considering audits of Permits-to-Work, which are in our opinion vital to management of safety on the refineries, the results show some improvement in the period since 2009, especially in work execution and closure of the permits, although there has been a deterioration in performance on permit issuing. The areas requiring and receiving attention in 2011 have been the risk identification, Safety Analyses (ART), training and authorisation of issuers, executors and receivers of permits, housekeeping, demarcation of work areas and closure issues. These concerns are being addressed by formal training, toolbox meetings, poster campaigns etc.

There is also a manual of lessons learned from past events. This initiative started last year, "Dupont" materials were purchased, including DVDs, on process, chemical hazards, driving, welding etc, permit-to-work, LOTO, and shows examples of "Best Practices", and where these are not necessarily properly applied.

Fire Protection

The organisation of the fire intervention forces is essentially unchanged. A planned from the fireprotection group is in the Maintenance department to progress the addition of firefighting systems into SAP. This includes the fixed protection systems located on the units and on storage (monitors, hydrants deluges, foam systems and the like). Detection systems for gas and fire remain by external contractors and are not included on SAP because they are maintained on contract by external companies.

24 new capital fire trucks have been received since 2004, and some 26 "old" trucks are retained and are, or are to be refurbished. The new trucks all have 3,000usgpm pumps and 200usg foam tanks, and are fully compatible with the 5"Ø Storch connectors used on the hydrants in the "high risk" areas of the site.

Fire Pump testing has not been carried out annually (2009 to 2012 Cardón Diesels, Electric pumps tested in 2011). Tests are programmed through SAP, so it is unclear why they are not scheduled in accordance with the NFPA requirements. The results for Cardón showed the electrical pumps to be satisfactory, but the diesels to need attention, one of them being 18% below the curve, and another suffering from a pressure relief valve passing at low pump flow (high pressure), although this did not affect the performance at high flows, where the pressure is somewhat lower and does not open the relief valve. There are recommendations to remedy pump 22, recalibrate the relief valve on Pump 23, and to replace pump 21. The Amuay pumps had also been tested, but we did not review the results.

A new system "SICOINE" (Sistema para el Control de las Inspecciones de Equipos Contra Incendio) was brought into use last year. This is a corporate initiative, and when fully populated will include all FIRE detection and protection apparatus. So far it is populated only by extinguishers, breathing apparatus sets, and fire trucks. For the firefighting vehicles, there is a status "tick list". The old paper system remains in use however, but is being migrated to SICOINE.

Security (PCP)

Security has an establishment of 159 to cover the two refineries, the marine facilities and the pipelines between the refineries. They can call on support from the armed services (National Guard) and armed contractors. The sites are well provided with access control and intruder detection, with an outer cordon plus an inner level providing access to the operating units and marine facilities. Access control has a database for validation of entry through the "badge controlled" access points. The security systems are in the process of being automated (CECON system), which should be completed by 2013. Improved communications (fibre-optic) between the two sites should be completed this year, improved perimetral lighting, and a new "Reaction Centre" for the National Guard. This represents a planned investment of US\$ 48millions.

10. Notable Incidents

Incidents are recorded on the "Meridium" database. These are broken down by area and by type: Operational, Incident, Accident, Vehicular, Electrical Failure, Fire, Spill, Leak, Emission or Other, and classified by risk as low, medium, or High.

During 2011, ~100 fires were reported to have occurred. Of these ~60 were said to be in oil contaminated "Trincheros" (pipe trenches). There was a total of 222 incidents reported (including these fires). Of these 9 were said to be "completed" (fully investigated and recommendations carried out, and included on the SISA database), 11 had been "divulged" (The investigation complete and the relevant people informed), 20 were being investigated, and 173 were at the "Comite" stage, i.e. a team had been allocated. Recommendations, where made, are progressed through the "SISA" database.

Incidents described to us during this visit are:

11/09/2010 Cardón Jetty 1 fire

Aviation Kerosene Jet A1 was being loaded via hoses to a tanker. The hoses had been installed in 2007, and had not been inspected, although it is understood that some had been replaced. A hose failed by a combination of fatigue and accumulation of tension/compression in curvature, this resulted in a cut to the vulcanisation layers. There were two loading pumps started simultaneously, and the resulting pressure surge is thought to have contributed to the cause of release. The resulting fire caused severe damage to the structure of the jetty, and it remains out of service. The regular strong wind is understood to have made the fire more intense. (See photographs below).

Action item from the incident is the institution of Annual or 6 monthly inspection of loading hoses. Hoses are extensively used at both Cardón and Amuay, for a variety of products including LPGs.

The Jetty 1 refurbishment features a reduced number of hose connections. (More Photos in "Observations" below)



<<Shows extent of repairs to jetty sub-structure.

And replacement of top-works, hose gantries etc.>>



We commented that there was no obvious marking on the hoses to indicate that they had valid recent tests, sinking in terms of stencilled obvious tag numbers and colour codes, rather in the manner used for lifting apparatus in many countries. Following the meetings, we were given details of a stamped identifier on one flange of the hose, and were shown a test certificate which incidentally was not dated.. This is not in our opinion "obvious". Identification or testing assurance.

15/03/2011, Amuay HDAY-4 86,000 b/d Gasoil Hydrotreater – Explosion

Operation was reported to be normal. The overhead line to the recycle gas compressor failed (700psig @ 110°F) The release, mostly of hydrogen and methane ignited and exploded. Release mechanism was external corrosion, under insulation. There had been more rainfall than in the past, and a heat tracing line was leaking, causing condensate to be trapped inside the insulation.

Because of the lower rainfall in the past, this line had not been identified as a candidate for CUI, and the Shell DEP had not therefore been fully applied.

After the event, the CUI plan has been formalised, and similar symptoms have been discovered on the same circuit of two other Hydrotreaters HDAY-2 (Distillates) and HDAY-3 (Gasoil). Clamps have been added where required, and the CUI plan extended to all units.

This, in our opinion, is a reactive response to the problem. (See above "Inspection")

24/05/2011 Cardon 77,000 b/d FCC Furnace Explosion

Loss of instrument air to a fuel gas valve was identified as the Root Cause, restored flow generated a flammable mixture in the combustion chamber, which ignited and exploded. Supplementary causes were alarm flooding – 350 alarms in 50 minutes (that's an average of 1 every 9 seconds), and the Re-Start procedure was out of date. Alarm rationalisation for the whole of Centro de Refinación Paraguana was recommended.

06/06/2011 Amuay HYAY2 9.5mmscf/d Hydrogen Plant (Reformer) Furnace F-851 Explosion

During a start-up after repairs to the furnace, there was an overpressure of tubes that had been "plugged", due to steam condensate being sealed into the tubes, and there being no mechanism whereby the trapped steam pressure could escape (The furnace temperature is ~1800°F) The subsequent explosion ruptured other nearby reformer tubes, which escalated the incident to a furnace fire which put the unit out of action temporarily.

Investigation revealed that no management of change was carried out with respect to the plugging of the tubes. As a pre-emptive measure, at least one tube that was not actually leaking was plugged, hence the overpressure and explosion. Proper drying of the tubes prior to plugging has been recommended. We suggested that holes should be drilled into tubes to be plugged, to remove any possibility of pressurisation.

06/01/2012 Cardon Platformer "Incipient" fire

Radiant Area Header leak and small (incipient) fire. In October 2011 there had been an over-temperature (850°C vs design 640°C) on 5 tubes, operating temperature was lowered and thermography increased to daily and cleaning frequency increased. Remaining life (creep life of tubes) assessed as very short, and visual inspections increased to 9 per day plus 2 thermographic inspections each day. Leak was discovered at visual inspection..

09/01/2012 Amuay PVAY 27,300b/d Vacuum Unit Unsafe Condition of Furnace F-100

Deformation discovered on carcase of F-100 furnace. Low thickness of refractory noted on lower area of furnace, weight of upper refractory had crushed lower refractory. Shut down and repaired.

05/02/2012 Cardon CDU4 70,000 b/d Crude Distillation Unit Fire.

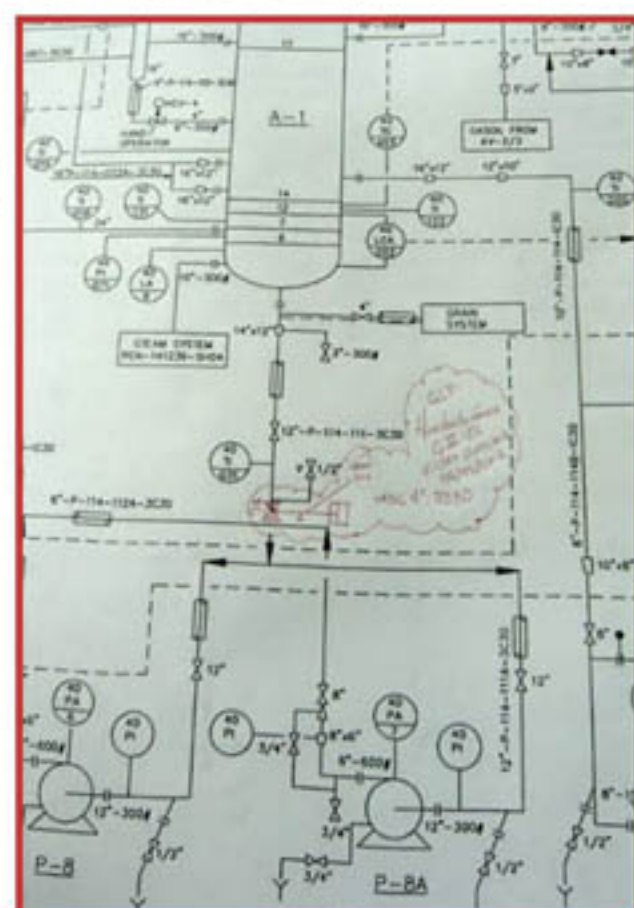


<<Column Bottoms Pumps suction line small bore drainage connection failed. Subsequent fire caused significant damage to unit, Remains out of action, Emergency Isolation Valves being installed as part of repairs – if installed sooner would have reduced the consequences. Note damage to underside of second level floor



One of the new EIVs

As shown on the "redline" P&ID. Note date of "redline".



We asked specifically to review the furnace incidents that have recently occurred, and it was concluded that there was no significant common causal factor – our initial concern that this unfortunate run of incidents may have been connected with operating heaters and furnaces beyond the useful life of their tubes has not been borne out by experience.

11. Loss Estimates Update:

The Estimated Maximum Loss, (EML) for insurance purposes, can be defined as the largest loss anticipated from the most severe occurrence possible to a location, causing widespread damage that renders fire protection and emergency shutdown procedures inoperative, or the systems operate without any changes in the final outcome of the loss. Only passive physical features such as spacing, fireproofing, diking, and topography are effective in limiting the loss.

At this site, the mechanism which has been identified as the worst incident is "Vapour Cloud Explosion and Fire Following", resulting from an uncontrolled release of flammable volatile hydrocarbons from process system containment, subsequent ignition, and combustion in the process units. Overpressures from the initial explosion are assumed to have disabled systems intended to prevent further release or to extinguish fires/cool structures.

We do not consider the probability of the incident – it is sufficient to say that whatever design, construction, inspection, maintenance, operation or protection measures are taken, the capacity for the worst event remains, and that there will exist the possibility of many potential lesser loss producing incidents.

Values

The properties at CRP were revalued by Advanced Appraisals (Brazil) in February 2010. The total replacement cost values for the two sites as of that date were declared to be:

Site	Plant & Equipment	Construction	Foundations	2006 Replacement as New Value	2010 Replacement as New Value
Amuay	US\$ 9.691Billion	US\$ 825 Million	US\$ 1.137 Billion	US\$ 5.902 Billion	US\$ 11.654 Billion
Cardón	US\$ 8.460Billion	US\$ 859 Million	US\$ 1.149 Billion	US\$ 4.843 Billion	US\$ 10.468 Billion

The 2010 valuation represents a very large increase in the replacement cost value for the site. Underwriters are advised to review the valuation against their conception of relative values for refineries of broadly similar scale and complexity worldwide.

Full detail of the valuation was given in Appendix A5 of the 2010 underwriting report. These were provided in Excel Worksheets, and reference the contents of each block in some detail. It has been possible to sum the contents of each block, and it is these block total values that have been used in the EML calculation

The 2011 values are merely indexed from the 2010 values by 1.5% across the board.

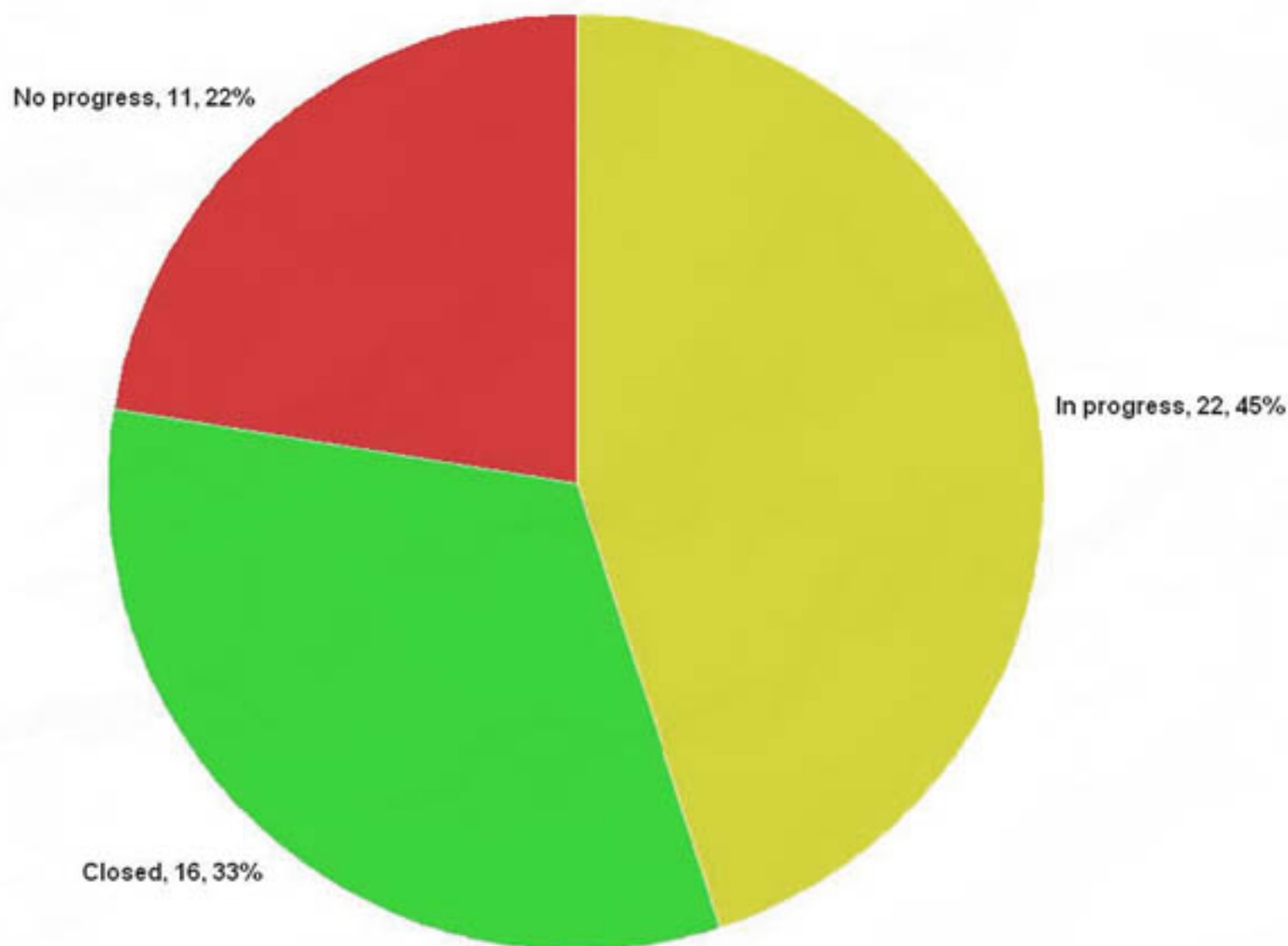
Site	2011 Replacement as New value
Amuay	US\$ 11.829 Billions
Cardón	US\$ 10.625 Billions

We have therefore chosen to not re-run the EML calculations, and have inflated the resulting estimated maximum loss by the same factor. For further details please refer to the 2010 underwriting report.

Site	Estimated Maximum Loss
Amuay	US\$ 3,356 millions
Cardón	US\$ 1.408 millions

12. Risk Improvement Recommendations Update

There are on record recommendations made during Risk Engineering Surveys of the Centro de Refinación Paraguana made during 1993, 2002, 2005, 2007 & 2010. These were included in the 2010 underwriting report in both English and Spanish. Progress on completion of these recommendations has been reviewed, based on reports and evidence made available by CRP management and observations made in the field by the two surveyors (Mr Roger Gregory, representing QBE, and Mr David Dalla Costa, representing Chartis). Only recommendations that had not been reported as closed following past surveys reports are addressed in this report Overall, at the commencement of the survey there were 22 outstanding recommendations comprised of a total of 49 uncompleted action items, and of these items we are able to report 16 (33%) closed, 19 (45%) in progress, and 11 (22%) with no progress (See Pie Chart below)



Summary of Recommendation Responses

Ref	Subject	Status	Comment
05.1993	Cardón Refinery: Independent High Level Alarms (Pressurised Storage)	In Progress	E2 Sphere implemented, during present TAM E1 Sphere planned for later this year
08.2002	CRP: P&ID memorandum (previously part of 05.1990 Technical Information in Control Rooms)	In Slow Progress (Long Term Project)	In Progress. Project progressing. Examples of newly "actualised" P&IDs were shown to us, although those we saw in control rooms were not "As Built", not authorised, some from 1997 (Maraven) issue drawings, and not "Autoplan" CAD issues. Few "Redline" changes recorded. It is unclear whether these are the "Master" P&IDs, or whether the concept of "Master" P&IDs exists.
10.2002	CRP: Housekeeping improvements	In Progress – Continuous Effort	Amuay housekeeping falls far short of expectations on units we visited. PSAY-4, PVAY-4. Cardon housekeeping was generally much better than before in the units visited. (FCC, PG2, CD4)
12.2002	CRP: Inspection program coverage of offsite pipework	Closed	Offsites Pipe systems on the refinery Now included in planned programme
02.2005	Wafer Flanges / Long Bolt Flanges	In Progress – No Physical Progress (4 parts)	Protection Jackets national supplier identified. Note these are not the usual "Stainless Steel Sleeves" most usually used for this purpose.
06.2005	Pressurized LPG Storage at Cardón Refinery	In Progress	E2 Sphere implemented, during present TAM, E1 Sphere planned later this year
11.2005	Emergency Isolation Valves (EIVs): Operation from the Control Bunker	In Progress	New EIVs at CD-4 have facility to operate from external safe location panel and from the control bunker. Not presently operable from control bunker (See Also Rec 2007.11).
01.2007	In-process fixed gas detection installation, plus maintenance and operator training on existing systems	In Progress but No Physical Progress	No additional detectors installed since 2009 upgrade of PG2 system. This has not operated successfully. Cards on order via Bariven, still not received. Original cards were damaged by incorrect grounding system. This issue said to have been solved for the Gas Detection System on this unit, although problem understood still to exist on other units. (See also 05 2010 re Bypassing during electrical Storms).
08.2007	EIVs Operability	Closed	Closed: Proof testing regime now established, including testing at planned shutdowns and other opportunities. Comprehensive Checklist now used for each valve. (example seen). No "Partial Stroke Testing" facility has been installed.
09.2007	LPG Sphere best practice for Sampling / Water draw-off	In Progress	Cardon Spheres reported to comply after audit. Amuay S 207 sphere being treated during TAM. Other spheres follow at their TAM – 3 in 2012 and another 3 in 2013.

11.2007	Improved provision of EIVs	In Progress (Slow)	328 valves originally identified. Scope now reduced to 21, using PDVSA 1997 criteria of 25m3 inventory. Another ~20 will be needed. Scope now includes Overhead drum sour water draw valves. 5 valves installed at CD-4. <u>Had this been implemented sooner, the consequences of the February 2012 CD4 fire would have been significantly reduced.</u> Legacy issues – Cardon EIVs are fail-safe pneumatic, those at Amuay are electrical drive.
12.2007	Floating Roof Tanks - Housekeeping & Grounding	In Progress	Schedule established starting January 2012, with checklist and register, however frequency is only one check per year. This we consider to be low for a task consisting of only a visual check.
14.2007	Management of 'Safety Critical' valves	1: No Progress 2: No Progress 3: No Progress 4: No Progress 5: No Progress	Still an inconsistent approach Some valves seen controlled using cable ties, however many others seen not to be controlled.
01.2010 Priority A	Fire-Safe/Fire Protected EIVs. Protection of Cables & General Cable Fireproofing	1 Closed 2 In Progress 3 Closed	Gap Analysis completed and fireproofing plan prepared Improvements to power cable fireproofing made on HDAY-4 (by PDV Maintenance) the four zones identified by us in 2010 in HDAY 4 are repaired. DKAY and ALAY being done during present TAM
02.2010 Priority A	ATS (Assessment of Safe Work). – to consider process hazards	Closed	Some modification of ATS, to include some considerations of process risks. But see Site Observation
03.2010 Priority A	Uncontrolled Bypasses	1 Closed 2 Closed 3 Closed	The "block" on C351 governor did not disable the protection, which is independent. Blue Book appears to be properly used and authorised. Regular audit carried out on rotating machinery protection.
04.2010 Priority B	Tank A7-2 Bund Contamination	1: Closed 2: Closed 3: In Progress	Cause found and eliminated. Contamination removed 2 other blocks of tanks identified with similar symptoms. Planned to be treated.
05.2010 Priority A	Long Duration Bypasses – (e.g. For Electrical Storm Threats)	1: In Progress 2: In Progress 3: In Progress	Cause identified as grounding of the protection system (Clean /Dirty Earth system), Varistors on order or being installed. Still some recent "Blue Book" entries of long duration bypasses for "Atmospheric Conditions" or "Rainstorms", even on units where it has not been a problem. Mitigation measures remain vague – "monitor the process" etc.

06.2010 Priority A	Control of Hazardous Energy during Maintenance: Positive Isolation, Definitions, Identification, Tagging, etc.	No Progress on any of the 6 points.	Full LOTO is not in practice. Dupont Training "Best Practice" taught, but not practiced. The PDVSA Norm also calls for full LOTO.
07.2010 Priority B	Register of Firefighting Equipment	1: In Progress 2: In Progress	Annual Plan local, but work entered into SAP when required. Early Days: "SICOINE" inventory and checklists etc. Are yet to be fully populated with all systems and apparatus. Only extinguishers, breathing apparatus, fire vehicles so far included.
08.2010 Priority A	Sphere Deluge Deficiencies	1: Closed 2: Closed 3: In Progress	See 07.2010 above
09.2010 Priority A	EIV Local Button Location, Labelling, Integrity and Lamp Function.	Closed	At Amuay, new motorised valve panels have been installed in some units, installation continues in turn-arounds At Cardón, Pillars identified by Yellow Paint, with push-buttons labelled by stencil.
10.2010 Priority	Anomalous Piping Thickness Measurement Readings in "SILCO"	In Progress – although not much apparent	Although it was explained to us that the problem arises only where there are small differences in readings, it is important that the principal of assuming that the previous reading was "correct" is not satisfactory. (symptom – apparent increase in wall thickness)

12.1. Recommendations from 1993 Survey

05.1993 Cardon Refinery: Independent High Level Alarms (Pressurised Storage)

05.1993 Alarmas independientes por alto nivel

An independent high-level alarm is recommended as a back-up to the existing high level alarm on the gauging system which is already relayed to the control room.

2005 Status: Open / *Abierta*

This recommendation is completed for all spheres, except E0-1 and E0-02. Installation of the independent high level alarm in E0-1 and E0-2 will be installed in 2006 during the shutdown of the LPG unit that will occur at the same time of the CCU.

Apr.-2007 AIG recommendation follow-up visit: *No physical progress. The same explanation was provided as in 2005 but this time with a planned shutdown of the LPG storage for August 2007 which will again coincide with a CCU shutdown. No Progress / *Sin progreso*.*

Nov.-2007 status: *No progress / *Sin progreso*. Once again delayed, this time to a January 2008 combined LPG / CCU shutdown.*

2009 Status: *Good progress (to be installed Q4 2009) / Detailed engineering done*

October 2010 Status: *No Further Progress since 2009. Reported in April 2009 "to be installed in Q4 2009"*

March 2012 Status: In Progress:

E2 Sphere implemented, during present TAM, E1 Sphere planned for later this year

12.2. Recommendations from 2002 Survey

08.2002 CRP: P&ID memorandum (was 1990-05 Technical Information in Control Rooms)

08.2002 Actualización de los PIDs (ya era una recomendación 05.1990)

The CRP practice is to have P&ID documents updated every six months. During the period in-between this regular update P&IDs can be modified with a red pen to indicate any changes. A P&ID containing the red pen mark-ups is comprehensively verified as representing existing process equipment before being made available for use. The master copies of P&ID documents are retained in the respective process area control rooms and the plant section heads have been designated as the persons responsible for ensuring their accuracy.

From a review of P&IDs in a number of control rooms the following concerns were raised:

- ✓ A large number of P&IDs do not contain an authorizing signature. Therefore, it is not clear if the P&ID documents have been reviewed to confirm technical accuracy and authorized for use.
- ✓ There is no indication on the P&IDs when red pen mark-ups were made and who authorized their addition to the master copies and their use.
- ✓ Some "Como Construcción" (As-Built), some "A.P. Construcción" (Approved for Construction) & "Original" document versions were present.

Therefore, it is recommended that only "As-built" P&ID's be used which should possess authorisation signatures from the CRP approval engineer. Furthermore, similar authorisation signatures should also accompany any red pen mark-ups.

2005 Status: Open. The renewal of P&IDs was started in 2000 but later interrupted in 2002 because of the strike. At the time of the survey 78 P&ID were reviewed and approved at Cardon (40 in Conversion, 28 in Deep Conversion, etc.). The rest of P&IDs at CRP will be updated in the period 2006-2007.

Apr.-2007 AIG recommendation follow-up visit: In Progress / En progreso

CRP's answer is that some 637 PIDs out of a total of ~1200 drawings were updated with the Novauser / Autocad platform during 2000-2006. In 2006, CRP opted for new softwares from Bentley which have "intelligent" integration applications: these are AutoPlant as drawing software and Projectwise as document visualization tool. The new applications are being used on a pilot project for actualizing the PIDs of the HDAY-3 plant. The project is planned for completion in Q3 2007 and will be followed by a 4-year program to actualize to "as built" conditions 100% of CRP's PIDs. CRP estimates completion of this recommendation for 2012.

Nov.-2007 status: In (slow) Progress / En (lento) progreso

During our visit of the control rooms at both refineries, we observed that some sets of PID's were kept on racks and in large format (A0). However, there were many missing PIDs; when available, most drawings referring to a given unit and kept together were out of sequence; the sequence was usually incomplete; drawings were uncontrolled copies and were missing revision dates for example as a result of any Process Safety Management action; some copies were also poor as dates could not be read etc... At Cardon, PIDs of the Gas Plant PG-2 date back to April 2002. At Amuay, PIDs of the light ends plant DCAY and GLAY showed Oct-1999 and Feb-2002 dates.

Discussions with the engineering department confirmed that initiatives on PIDs actualization are essentially contained within the pilot project described in the Apr.2007 status. All PIDs (20 off) for Amuay hydrodesulfurization HDAY-3 have now been updated using the Bentley's Autoplant application. These PIDs were being circulated for approval by all disciplines before to be officially authorized and issued to end users like Operations teams. It was stated that these updated PIDs would be available in the control room by Dec-2007 (note that the pilot project was initiated in May-2007!) and that replication of this exercise had started on Cardon's DCU which counts approx. 86 PIDs. Amuay HDAY-4, which is a twin unit of HDAY-3, is another next candidate plant for the drawings actualization.

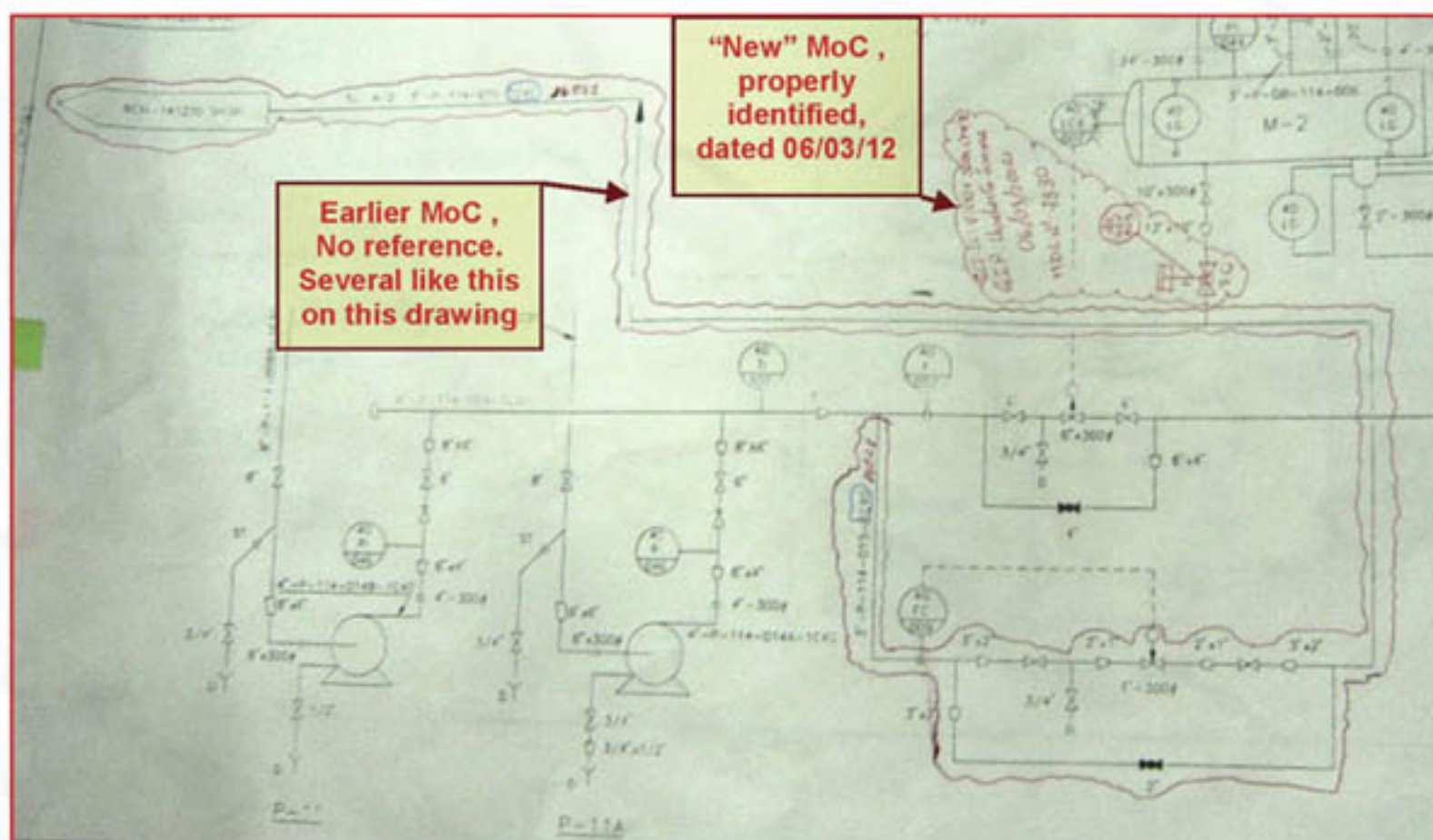
The engineering department is aware that progress is slow and that the amount of work left is considerable. The target of updating CRP's circa 1200 PIDs by 2012 appears unrealistic with the current level of human resources and the engineering department explained that it was looking for more support from management. At the wrap-up meeting, the survey team reminded CRP management of the importance of the PIDs actualization and called for CRP management to commit more resource to this task.

2009 Status: In progress (long term job)

Status October 2010 In Progress (Long Term Project) Autoplan P&IDs slowly progressing. P&IDs in control rooms, some evidence of "redlines" on drawings, or other updates, (e.g. on 1994 "Detailed engineering" issue drawing at Cardon Lubricants unit – actualised in 2007 without comment

March 2012 Status: In (Slow) Progress:

The so called "Master" copies of the P&IDs are kept as stick files in the control bunkers. "Actualisation" is said to be carried out, as part of the HazOp process, and this involves "walking the lines". About 80 are being done per year, and these are not being put into the control buildings until the HazOps are done. In our opinion, this is not logical – the "Master" drawings should be available for operational purposes. We noted few redline changes on the drawings we reviewed in the control buildings, and some of those we saw were confused, with the change "Clouds" not referenced to the authorisation or management of change number. There were also some changes that had been added very recently, for changes made in 2010, and the new EIVs redlines had been added during our visit. (See below)



The condition of some "master" drawings on stick-files was questionable (left), although we have been shown "actualised" drawings, properly approved (centre and right).



APROBACIONES		FECHA	
Operaciones	José Russell	22/04/12	
Ing. de Procesos	Luis Ruiz		
Control de Procesos	Xavier Bustidas		
Q12 Instrumentación	H. Jordan		
Q13 Ing. Planta	Arturo Gómez	23/03/2012	
Q14 Corr. M&E	Selec Perea		
Q15 Ex. Rotación	Domagoj Mijovic		

Refi-pedia

Rev.	DATE	REVISION DESCRIPTION	APP.
0	08-04-08	ISSUE FOR REVIEW	
1	07-06-08	REVISED PER CUSTOMER COMMENTS & PER ATTACHED LIST ISSUE APP FOR COR.	T.M.
2	02-06-08	REVISED PER ATTACHED LIST	E.B.
3	20-12-08	REVISED PER ATTACHED LIST	C.R.
4	15-04-09	REVISED PER ATTACHED LIST	C.R.
5	16-09-09	REVISED PER ATTACHED LIST	M.P.
6	-03-09	MODIFICACIONES PARA OPERAR HD-2 A TAMB. PROYECTO IMP-7	T.M.
7	FEB-12	PROYECTO ACTUALIZACION P&ID'S	

PIPING AND INSTRUMENT DIAGRAM
MIDDLE DISTILLATE HYDROFINER (HDAY-2)
REACTION SECTION

PETROBRAS DE VENEZUELA S.A.
JUDAHY FALCON, VENEZUELA

SHEET NO. 3 DE 4
8764-R-0050-1 REVISION 7

10.2002 CRP: Housekeeping improvements

10.2002 Mejoras de orden y limpieza

Generally, process areas are kept clean and free of debris. However, three specific areas that could be improved are:

- ✓ Debris stored in vessel skirts found in a number of process units.
- ✓ Explosion proof boxes containing electrical circuits were loose, thus compromising protection against hydrocarbon vapour ingress.
- ✓ The offsite pipe trench on the Cardon site contained a significant quantity of oil and water covering the lower part of pipelines located in the trench. There were also planks of wood (scaffold boards), riggers gloves, spare bolts, etc.

Therefore, it is recommended that these housekeeping situations be rectified as soon as possible. Furthermore, verification that these areas remain clear in the future, their inspection should be incorporated into site safety walkabouts.

2005 Status: Open. No Progress / Abierta. Sin progreso.

Despite the extensive audit of process areas, the site tour has confirmed in few occasions that debris, trash and tools are stored in column skirts (Lube Plant and CD3 at Cardon, Isomerization and DCAY (T2501) in Amuay). Similarly explosion proof boxes containing electrical circuits were found loose. At the close out presentation, it was recommended to CRP to include these topics in their check list during the operation safety walk or HSE audit.

Apr.-2007 AIG recommendation follow-up visit: No Progress / Sin progreso

During the site tour, some debris and tools were found in column skirts and explosion boxes containing electric equipment were found not properly bolted.

Nov.-2007 status: No Progress / Sin progreso

Housekeeping standard in many of the visited process units at both refineries was still inadequate and many anomalies, often the same as in previous visits, were noted: accumulations of debris from maintenance activities, piping insulation falling apart, below average hose discipline, some occurrences of missing caps/plugs for example on the drains of fuel gas lines to heaters/furnaces, pumps full of sludge for example at Cardon FCCU and Amuay Crude unit 5. Housekeeping in these two units was disappointing while credit should be given to the much better and adequate housekeeping observed in Amuay light end recovery unit (GLAY) and Amuay Flexicracker area (DCAY). However in DCAY, a blatant occurrence of inadequate bolting was observed on the two electrical boxes Z406/Z407 (each box was only closed with 2 bolts when 24 are normally required).

Status 2009: In progress (improvements seen on integrity issues, but PS-3, VAC-4 still gives cause to concern)

Status October 2010 In Progress Some improvement seen on integrity issues, PDA1 & 2, Coker, Pipeways, however, rubbish seen in vessel skirts in CDN Coker, PSAY 5 column drain, numerous missing plugs in ISAY, missing bolts on electrical boxes, conduit covers missing, luminaires without glass or guard etc.)

March 2012 Status: In Progress: continuous effort remains necessary.

Still below standard at Amuay, but much improved on Cardón. Example below from Amuay.



12.2002 CRP: Inspection program coverage of offsite pipework

12.2002 Incorporación de las líneas off-site al programa de inspección

Over the past few years, there have been a number of losses originating from off-site pipework that was not sufficiently covered by an inspection program. Accordingly, the inclusion of off-site pipework in any corrosion monitoring program should be implemented as soon as possible. From discussions with CRP inspection specialists they are considering whether to include the monitoring of off-site pipework into their advanced SILCO program.

Therefore, it is recommended that the introduction of off-site pipework into the SILCO program should be implemented at the earliest possible time.

2005 Status: Open / *Abierta*

Only 10% of the total work has been carried out so far. CRP have listed all Amuay's off-site pipe work (at the jetty and at the process units) that need to be part of a corrosion monitoring program; this list still need to be developed for Cardon. Once both lists will be available, CRP will start working on the isometrics and on the setting of an inspection frequency. All these activities will be sub-contracted. Completion of the system is expected by December 2006.

Apr.-2007 AIG recommendation follow-up visit: In Progress / *En progreso*

Off-site pipework for 7 areas at Cardon have now also been identified in addition to the piping systems already selected at Amuay. CRP estimates the overall progress at 31% and the 2008 as the completion year.

Nov.-2007 status: In Progress / *En progreso*

For Cardon: physical condition evaluation, isometrics, repair orders and inclusion in SILCO have been carried out for the piping systems between plants, between plants and storage and between storages. This work is pending for the lines connecting the storage areas and the jetties. CRP's own estimate of progress is 90%.

For Amuay: Lines had already been identified as per previous status reports, but CRP opted for a recheck of the available information to proceed later on with the inclusion of information into SILCO. CRP's own estimate of progress at Amuay is 26%.

Note that CRP has reviewed to 2009 the completion year on this recommendation.

Status 2009: Closed (*Jetties dispatch lines are still pending but to be complete end 2009*)

Status October 2010 Re-Opened *Jetties dispatch line inspections are still pending despite commitment to complete by end of 2009*

March 2012 Status: Closed

There are 59 manuals for line inspection of all lines on site, with procedures and inspection points. Outside Battery Limit Lines and Jetty lines are done.

12.3. Recommendations from 2005 Survey

02.2005 Wafer Flanges / Long Bolt Flanges

02.2005 Bidas de tipo wafer / bridas con espárragos largos

During the visit of the process areas at CRP it was noticed that both refineries make an extensive use of wafer flanges / long bolt flanges. The long bolts will be receive direct flame contact if there is a fire in the area; the direct flame contact causes the bolts to expand rapidly and lengthen, allowing both gaskets to leak product. The leaking material then adds fuel to the fire and if under pressure it causes a large spraying fire that results in much more damage. It is recommended the following:

- Identify Long Bolt Flanges
- Assess Fire hazard from the contained material and location hazards.
- To limit the problem of fast failing Long Bolt Flange valves they should be replace with normal flange valves, but the hazard can be reduced by wrapping the long bolts with a fire resistant material and then enclosing the entire assembly with a stainless steel covering. In addition CRP should progressively remove Long Bolt Flange when in Flammable liquids or LPG service.
- Update PDVSA engineering standard in order to ensure that every new process unit will not have Long Bolt Flange Joint installed any more.

2005 Client Comment: CRP will conduct a gap analysis across the site by February 2006, and will propose an action plan in order to upgrade all wafer flanges existing in the complex. By March 2006 it is expected that all wafer valves are identified. By September 2006 CRP will revise PDVSA Engineering Standard in order to avoid the utilization of wafer valves in new projects. Accountable: Maintenance.

Apr.-2007 AIG recommendation follow-up visit: No Progress / Sin progreso

No concrete improvement on the plants, hence the given "no progress" status. CRP stated however that it plans to identify the number of inappropriate arrangements in 31 units planned for maintenance shutdown in 2007 and to fit these valves with thermal isolation. In subsequent main turnarounds, and where technically possible, the valves will be replaced by normal flanged systems. The scope of work for 18 units planned for turnarounds in 2008 is also being defined and will contemplate the replacement of any long bolted flanges identified in these units. CRP also agrees to no longer specify wafer type of valves for flammable liquids or LPG service. No information provided on whether PDVSA Engineering Standards have been formally revised or not.

Nov.-2007 status: No Progress / Sin progreso

Many long bolted flanges were observed across the units and none was observed with a fireproofing protection, hence the attributed "no progress" status. CRP stated to still be in the identification phase (apparently 700 long bolted flanges were listed along with diameters and ratings data). CRP stated that the collected information was being reviewed by its Engineering Department (GII-IP and GII-IC) which will issue the technical specifications required for the provision of fireproofing blankets.

For the units scheduled for turnaround in 2008, CRP's explanation is as per the April 2007 status report. CRP also stated that the relevant PDVSA Engineering Standard(s) was/were under review (no specifics provided).

2009 Status: In Progress Inventory done, risk matrix to prioritized the ones to protect, standard is written & being culated, memo for new projects. But no action on site + unaware of time scale

October 2010 Status: No Progress since 2009

March 2012 Status: In Progress

Nothing physical yet, but local manufacturer of fire resistant jackets has been identified. These are not the suggested stainless steel band type, although if conscientiously replaced after access needs, are believed to be adequate.

06.2005 Pressurized Storage at Cardon Refinery

06.2005 Almacenamiento de GPL en la refinería Cardon

During the next CCU shutdown, CRP is planning to install ROV on spheres E-01 and E-02. It is recommended to install the valves as closest to the bottom of the sphere and not at the current location that is outside the bund area. In addition the valve should be of fail close type and remotely operated from the control room.

It is also recommended to update PDVSA engineering standard with the above recommendation and develop a plan to upgrade all other spheres with the above recommendation.

2005 Client Comment: A recommendation will be issued in order to install ROVs in both spheres during the CCU turnaround that will occur in March 2007. CRP will revise, by February 2006, the PDVSA Engineering Standard in order to include the change of the location for the ROVs.

Apr.-2007 AIG recommendation follow-up visit: In Progress / En progreso

CRP's engineering department (GII-IC) issued the technical recommendation during 2006 for the installing the ROVs as recommended. This will happen at the LPG shutdown now rescheduled for August 2007. The revision of the corresponding PDVSA standard is still intended as is the modification of any of CRP's LPG storage that would not be comply with the updated standard (accountability to GII). A first meeting with INTEVEP in March 2007 is foreseen as a starting point.

Nov.-2007 status: In Progress / En progreso

The valves installation is now planned at the same time as the January 2008 CCU shutdown.

For the remaining points, the only progress stated by CRP is the setting up of a team to revise the corporate standard which will be then be used in the elaboration of CRP's LPG storage modification program.

2009 Status: Good Progress on E01 & E02 Spheres, EIVs operable from the bunker to be installed in October 2009

October 2010 Status: No Progress since 2009

March 2012 Status: In Progress

E2 Sphere implemented, during present TAM, E1 Sphere planned for later this year

11.2005 Emergency Isolation Valves (EIVs)

11.2005 Válvulas de bloqueo de emergencia (EIVs)

CRP has already fitted a high number of EIV's across the site. In addition to the actuation device installed on the field (push button); it is normal practice in the industry to have valves isolating large inventories remotely operated from the control room; therefore it is recommended to install a actuation device in the control room for all EIV isolating critical inventory and critical flows, in order to ensure a prompt response.

The current PDVSA standard includes actuation devices in the control room only for compressors but not for critical inventories. It is also recommended to update the PDVSA engineering standard.

2005 Client Comment: In reference to the PDVSA's standard on EIV, CRP will evaluate the recommendation.

Time Frame: Sep. 2006

Apr.-2007 AIG recommendation follow-up visit: In Progress / En progreso

Remote operation (from the control room) of existing EIVs currently fitted with actuation device located in the field will be installed in Cardon FCC unit as part of the capacity expansion and turnaround carried out in early 2008. For these EIVs, engineering and procurement are 100% are completed.

For the remaining units, CRP states that the improvement is included in the normal units turnaround schedule with an estimated completion year of 2012. No details were provided.

Nov.-2007 status: In Progress / En progreso

Same situation as in Apr. 2007 for Cardon FCC area with a completion date estimated for May 2008.

Plans for 2008 also includes carrying out the EIVs modification on Cardon atm. CD-4 unit (5 EIVs – tags 40-HSV-001/2/3/4/5) and Cardon vacuum AV-2 unit (3 EIVs – tags 60-HSV-001/2/3) during the corresponding plant turnaround scheduled for Q3-2008.

CRP stated that a team has been set up to revise the corresponding corporate standard.

We consider that the announced EIVs modifications on Cardon FCC and distillation areas should first materialized and be witnessed by insurers, and that CRP should provide the program of actions for the remaining EIV retrofitting work, before to consider closing this recommendation and tracking separately the progress for example in the project section of the underwriting report.

2009 Status: *In progress (GAP analysis done, prioritisation being done)*

October 2010 Status: *In Progress Total of 36 valves identified as needing control room actuation. No physical progress so far.*

March 2012 Status: In Progress

New EIVs at CD-4 have facility to operate from external safe location panel and from the control bunker. Not presently operable from control bunker (See Also Rec 2007.11).

12.4. Recommendations from 2007 Survey

01.2007 In-process fixed gas detection installation, plus maintenance and operator training on existing systems

In-process flammable gas detection is either absent or very limited in most units at both refineries. Furthermore, when installed, numerous gas detectors were found to be no longer operational. There are numerous case studies in the industry, an example of which is the Phillips 66, Pasadena, USA, 1989 explosion, illustrating that early leak / gas detection is essential to the initiation of rapid remedial action.

The following improvements should be implemented:

1) Strategically install flammable gas detectors, alarming in the control room, in those process units with significant inventory of light hydrocarbons (particularly LPG holdups in process vessels such as reflux, feed and surge drums, columns etc), and specifically around those items of equipment handling light hydrocarbons. For implementing an effective gas detection coverage, identify and risk assess the probable leak sources which could lead to the formation of flammable gas clouds, e.g. high pressure equipment / joints, compressor seals, pumps handling flammable liquids/vapours with an Op. temperature higher than their flash points, manifolds where many control valves are grouped with multiple flanged connections, letdown valve etc... The recommendation is applicable as a first priority to process units not already fitted with gas sensors, but should also be considered for LPG storage for which the provision of gas detection has already be the subject of other recommendations. Area detection (line-of sight devices) as well as point detectors should be considered.

2) The operational status of gas detectors provided in unit 96 Reformer & HDT area at Cardon is accessible on a plant mimic display in the main control room. During the visit, it was observed that this display showed 5 gas sensors in a "fault" mode and 2 others in "alarm" mode out of a total of 10 installed detectors, i.e. at least 50% of the gas detection coverage was not ensured. The following deficiencies were also noted about the panel operator in charge:

- Inability to provide any explanation about this faulty and alarm mode situation and its duration
- Issue not recorded in any of the operator logbook
- Lack of knowledge about the function and field components of the gas detection system
- No particular remedial action had been taken to respond to the gas alarm

On further investigation, maintenance also indicated that discrepancies may exist between the gas detectors shown on the control room displays and the ones actually installed within the units. The extent of such discrepancies is not known by maintenance, nor is it known by operational staff.

It is therefore recommended to:

- a) Audit other units fitted with gas detection, at both refineries, to identify potential similar shortfalls and apply the improvements listed below.
- b) Inspect, prove and maintain existing gas detection system
- c) Ensure that control room displays accurately reflect field instrumentation
- d) Regularly train operators on gas detection system and the required actions to take on the receipt of a gas alarm (all possible alarm scenarios should be considered such as alarm from a single detector, from multiple detectors, pre-alarm only, higher alarm levels etc...)

2009 Status: In Progress overall

- 1) *Project* → only half way through the concept stage, hence very little progress
- 2) *Maintain & training* → Closed

Seen functional on DCS in CR + Ops instruction issued.

October 2010 Status: In Slow Progress

- 1) *Project* → Units prioritised according to Dow/AIChemE rating. Upgrade done on Cardon PG2, however not properly functioning. No specification yet for other units. Concept only. No project time-line established.

March 2012 Status: In Progress – No Physical Progress

- 1) *No additional detectors installed since 2009 upgrade of PG2 system. This has not operated successfully. Cards on order via Bariven, still not received. Original cards were said to have been damaged by incorrect grounding system connection. This issue said to have been solved for the Gas Detection System on this unit, although problem understood still to exist on other units. (See also 05 2010 re Bypassing during electrical Storms).*

08.2007 EIVs Operability

Picture 5 here below shows the emergency isolation valve (EIV), HCV-432, installed in the suction of a hydrocarbon pump, at Cardon's gas plant PG2. As it can be seen, the arrangement is such that the EIV actuator and remaining valve assembly is horizontal, but the actuator, which is sizeable, is not supported and because of its weight it appears to put a lot of stress on the valve stem, which could impede the proper functioning of the EIV when required. Pictures 6 a & b are close views of the stem and actuator and clearly shows significant rusting and degraded physical conditions, which adds further doubts on the EIV operability. The main concern from the survey team is that the EIV could be stuck open in case a demand from the process occurs. This example also raises the issue of EIV proof testing. Also, during the visit of the installations, it was observed that many EIVs, normally fitted with fireproofing blankets, had the fireproofing protection not properly in place or removed following for example maintenance work on the EIV. This was observed within the process units but also in the LPG pressure storage spheres at Amuay.

It is recommended to:

- 1) Provide adequate support to HCV-432 actuator at Cardon's gas plant PG2 and carry out any required maintenance and testing to ensure the valve operability on demand.
- 2) Audit the installations to identify other sizeable EIVs lacking adequate supports and/or in similar unsatisfactory physical conditions, as HCV-432, and provide the remedial solutions as in point 1.
- 3) Review and strengthen CRP's EIVs maintenance and proof testing philosophy to reduce the occurrence of dangerous valve stuck failure conditions, as in HCV-432 case.

For example:

- where spare EIVs are installed, for example where they are fitted to pairs of "spared" pumps, test them between turnarounds and not only at turnaround
 - consider implementing partial valve stroke testing, to ensure that the valves remain operable, without the need for shutting down the process.
- 4) Identify EIVs where fireproofing protection (blankets, jackets etc...) has been removed and not adequately put back, and restore it where needed. Also, make the reinstallation of these fireproofing items a requirement in the acceptance step of work permit activities and raise awareness about this point of personnel involved in those activities (contractors, plant operators etc.).

2009 Status: In progress, overall

- 1) Cardon's PG2 valve → Expired
- 2) Valve support & Operability audits → Done, said no improvements to support needed
- 3) Maintenance & proof testing improvement → No progress

October 2010 Status: In Progress

3) In Progress: Maintenance & proof testing improvement: Spared EIVs still tested only at TAM. No movement towards Partial Stroke Testing. Electric actuated valves not tested at TAM. Split of responsibility for valve (mechanical) and Actuator (Instruments) Memo (07/10/10) clarifying procedure, simple check.sheet produced, intention to use as part of pre.start checks after TAM and other shut.downs.

Comment: Make as mandatory pre.start requirement

4) Closed: Fire.proof jackets seen to be improved on site, following memo. However inconsistencies still exist. There are however electrical cables/conduits that are not fire protected. (See New Rec 2010.01)

March 2012 Status: Closed

3) Closed: Proof testing regime now established, including testing at planned shutdowns and other opportunities. Comprehensive Checklist now used for each valve. (example seen). No "Partial Stroke Testing" facility has been installed.

09.2007 LPG Sphere best practice for Sampling / Water draw-off

Leakage when taking a sample or drawing water from LPG storage, in particular the failure to isolate following such operation, has been recognised as one of the major LPG release cause leading to accident. When visiting the LPG sphere area at Amuay, it was observed on sphere 209 that the water drain line consists of a first ¼ turn valve and a second globe valve which are separated by only 1 foot. This separation distance is considered to be insufficient and the valves could freeze in the open position following sampling or water draw-off operations. It was also observed that the sampling point terminates directly underneath the spheres, which is not the preferred layout. (Such a design was a key factor in the Feyzin LPG sphere "BLEVE" in France, 4th January 1966, see "<http://www.hse.gov.uk/comah/sragtech/casefeyzin66.htm>")

It is recommended that:

- 1) the double valve isolation on the LPG sphere 209 at Amuay water drain line be modified to introduce at least 1m between the valves. Note that this is also valid on any sample point.
- 2) the sampling point on the LPG sphere 209 at Amuay be relocated away from the shadow of the vessel. Samples could for example be taken of the water drain line. Note that water draw-off lines should terminate at least 3m (10ft) outside of the shadow of the tank.
- 3) an audit is carried out to check whether similar configurations exist elsewhere, at Amuay and Cardon, and a programme of improvements be developed.

Refer to API standard 2510 "Design and Construction of LPG Installations" for best practices on LPG sample points.

2009 Status: In progress

GAP analysis done, EIVs in water drain lines will be installed, etc.

October 2010 Status: #1, #2, #3 Overall, No Further progress

Sphere 209 sample point remains under the vessel, top valve was open. Sphere 208 sample point in bad state so sample taken from gauge connection, top valve open. Distance between sample valves does not comply with PDVSA 1.5m criterion. No progress on implementation on other spheres.

October 2010 Status: : #1, #2, #3 Overall, No Further progress

Sphere 209 sample point remains under the vessel, top valve was open. Sphere 208 sample point in bad state so sample taken from gauge connection, top valve open. Distance between sample valves does not comply with PDVSA 1.5m criterion. No progress on implementation on other spheres.

March 2012 Status: In Progress

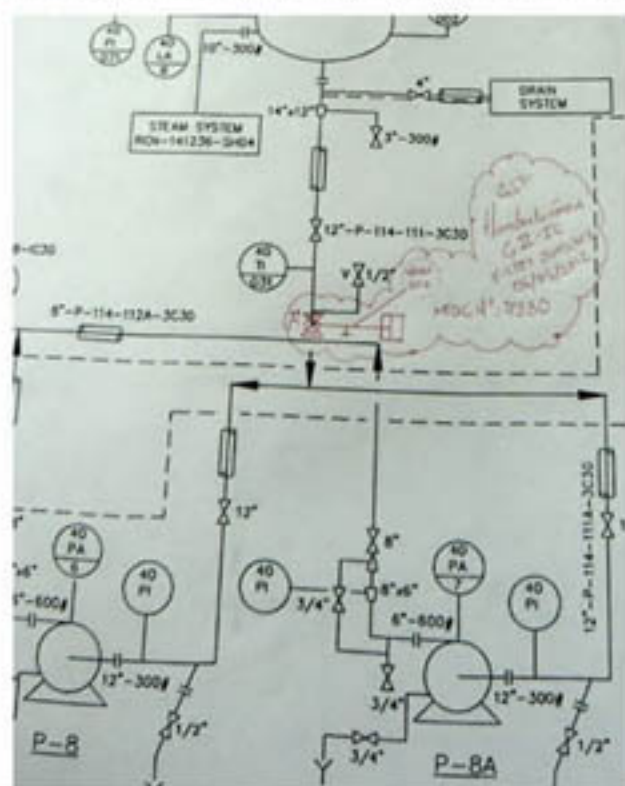
Cardon Spheres reported to comply after audit.

Amuay S 207 sphere being treated during TAM. Other spheres follow at their TAM – 3 in 2012 and another 3 in 2013.

A number of emergency isolation valves are already installed across the units at Amuay and Cardon, however it was observed that there are still significant LPG inventories which are connected to pumps and for which the isolation is manual between the vessel and the pump in case of an emergency at the pump e.g. seal failure. The gas plants at Amuay and Cardón are our principal concerns although other plant areas may also be involved. Furthermore, the inventory threshold defining the vessels that should be protected by EIVs is now becoming more and more stringent in the industry.

1) Audit the units to identify all the inventories, connected to pumps with only manual isolation between the pump and the vessel, and with normal liquid levels over 5 m³ of LPG type material or 10m³ of other hydrocarbons Op. at temperature above, at or close to their flashpoint or auto-ignition temperature. For the systems meeting those criteria, install EIVs in the discharge lines of the vessels to the pumps. These valves should be installed as close as possible to the vessel or drum and be capable of being actuated from within the appropriate control room (see recommendation 05.11) and from a safe location within the process units. It is reminded too that the valves, actuator and cabling should have a fire rating of 20 minutes.

328 valves originally identified. Scope now reduced to 21, using PDVSA 1997 criteria of 25m³ inventory. Another ~20 will be needed. Scope now includes Overhead drum sour water draw valves. 5 valves installed at CD-4. Had this been implemented sooner, the consequences of the February 2012 CD4 fire would have been significantly reduced. (See pictures below). Legacy issues – Cardon EIVs are fail-safe pneumatic, those at Amuay are electrical drive.



12.2007 Floating Roof Tanks - Housekeeping & Grounding

The following anomalies were observed when visiting crude storage tanks 106 and 164 at Amuay:

- Excessive vegetation growing out of control in tanks bunds (see picture 8 a).
- Roof seals excessively contaminated with oil, which could be a contributing factor to hydrocarbon ignition and rim fires for example in case of a nearby lightning strikes (see picture 8 b).
- Some electrical shunt sections normally ensuring the electrical continuity between the floating roof and the tank shell were broken, hence increasing again potential secondary lightning effects such as bound charge and secondary arc (see picture 8 b).
- Tanks grounding at the tank bottom not easily identifiable because of excessive vegetation and, in some cases, missing. (This is recognised by PDVSA, in that the Exxon design does not specify electrical grounding of the tanks, but the Shell design does. PDVSA expressed an intention to ground all tanks.)

It is recommended to specifically address the type of anomalies highlighted on tank 106 and 164 and by extension establish a programme to improve housekeeping and electrical grounding standards on all CRP's floating tank storage facilities, i.e. establish a bund vegetation control programme, maintain roof seals in a clean condition, ensure adequate electrical continuity between floating roof seals and tank shell as well as adequate tank grounding.

2009 Status: In progress

Need more proactivity in reporting seal conditions, shunts etc.

October 2010 Status: In progress

Reported checklist in use, and archived. (Checklist not seen)

Tank seen (A7.2), Lagomar 5 Light Crude, holes in weather seal, gaps between wall and seal, roof seal flooded. (See photo)



March 2012 Status: In Progress

Schedule established starting January 2012, with checklist and register; however frequency is only one check per year. This we consider to be low for a task consisting of only a visual check.

14.2007 Management of 'Safety Critical' valves

'Safety Critical' valves include all those valves required to be in the open or closed position for safety reasons. Examples include, but are not limited to, any valves in a pressure relief path, any valves in the firewater or other fire protective system and any valves associated with the ESD/EDP system (eg. isolation and bypass valves).

It is recommended that these valves are:

- 1) Identified in the field (e.g. painted and tagged with unique reference number)
- 2) Identified on the P&ID (eg. Safety Critical Valve Open (SCVO) or Safety Critical Valve Closed (SCVC) designation)
- 3) Locked or car-sealed in the required 'safe' position, as indicated on the PID
- 4) Listed on a register held in the Control Room and any operation involving closing "SCVO" designated valves or opening designated "SCVC" valves to be controlled using the permit-to-work system or the safety interlock bypassing procedure as appropriate.
- 5) Periodically checked to ensure they are in the correct 'safe' position

2009 Status: some progress. (Not all valves identified in our opinion)

October 2010 Status: Some progress. Most valves seen controlled using cable ties, however some seen not controlled

March 2012 Status: No Progress – if anything, some regression

Still an inconsistent approach

Some valves seen controlled using cable ties, however many others seen not to be controlled.



12.5. Recommendations from 2010 Survey

01.2010 Fire-Safe/Fire Protected EIVs, Protection of Cables, & General Cable Fireproofing

Priority A

There are many electrically driven Emergency Isolation Valves (EIVs) at CRP. These require a reliable source of electrical energy and signal to operate. For this reason, where they are located in a fire zone, they are generally to a fire-safe design (actuator and valve body), or are fitted with fire insulation jackets. Similarly, cables run through a fire zone, are generally protected from fire using a jacket or coating.

During our site visit many cases were seen where the protection to the cables and their conduits was incomplete. Most prevalent was failure to protect the flexible conduits carrying the cables from the rigid conduit to the actuator body, although cases also were seen where the conduit was not protected. In such cases the cable could be expected to fail rapidly if exposed to fire.

We also noted cases of highly significant electrical and/or instrument cable trays (e.g. in HDAY-4) which were protected by a proprietary fire resistant jacket, which had degraded in the ambient conditions to the extent that it was essentially non-existent.

We Recommend:

- 1 That a gap analysis be carried out to determine where cables serving electrically driven EIVs are within a fire zone.
- 2 That cables found to require protection be fitted with protective jackets/coatings.
- 3 That the condition of fire protection to important instrument and electrical cable trays be assessed and prompt replacements made where necessary.

Client Comment:

None received

Status March 2012:

- 1) **Closed:** Gap Analysis has been completed. There is a "Fireproofing Plan" covering passive protection to structures and cables.
- 2) **In Progress:** Electrical driven actuators are generally "K-Mass®" protected. Cables are being treated by a contractor during turn-arounds. HDAY- 4 said to be completed. DCAY and ALAY will follow during TAM.
- 3) **Closed:** the four zones identified by us in 2010 in HDAY 4 are repaired. DKAY and ALAY being done during present TAM

The "Identificación de Riesgos" and associated "Adiestramiento/Certificación Requerido en Prácticas de Trabajo Seguro" are job safety analysis used in conjunction with the Permit-to-Work to inform all staff and workers of the hazards which may be associated with the work to be undertaken and the appropriate procedures and protective measures. This concentrates solely on risks to the workers, specifically at the site of the work itself, and does not consider broader process hazards, potential damage to equipment, or hazards that may be introduced remote from the work site. Although in many cases this will also protect the process, this is not always the case, and significant losses in the past have resulted from failure to recognise process hazards.

We Recommend:

That a multi-disciplinary team should study generically the process hazards that may be introduced in the preparation and execution of the work, and subsequent return to service of the equipment and systems involved.

The study should consider the consequences of intended actions, unintended actions and omissions in the work, to the immediate process, to other connected systems or apparatus and to the surrounding environment. It is suggested that a "What If?" format of study would be suitable, with the target of including such hazards on the ATS checklist.

Client Comment:

None received

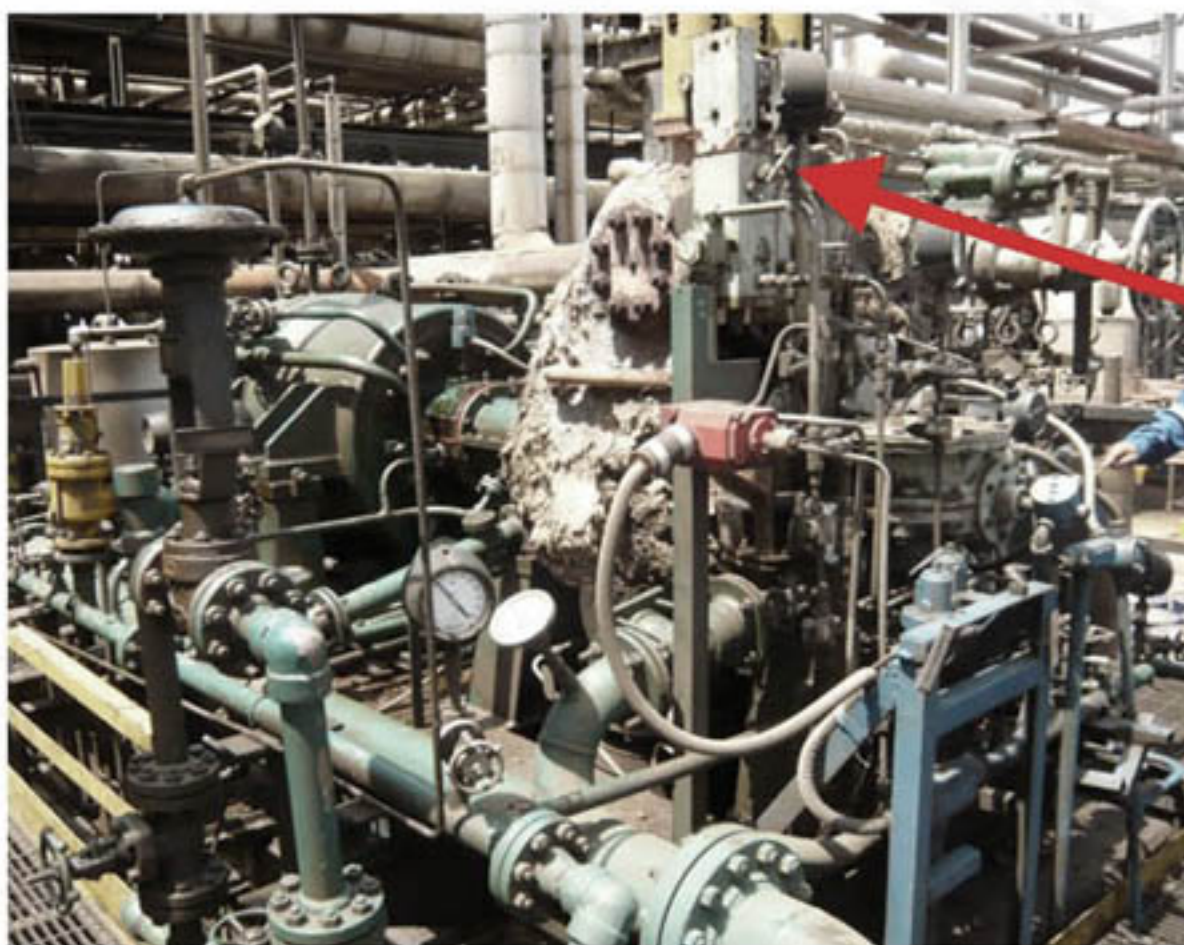
March 2012 Status: Closed

Some modification of ATS, to include some considerations of process risks.

However we note that items such as "Lifting Plans" for use of cranes etc. are applied rather generically and consider mostly weight/balance and security of slinging issues. On these there is no apparent consideration of the consequences of dropped load on apparatus and pipework over which the lift is to take place. (Example seen on Amuay Jetty 2)

On the HDAY-4 unit at Amuay, the hydrogen recycle compressor (C-351) steam turbine governor was seen to have an improvised physical block placed to impede action of the governor. On investigation, it was learned that this, and a block to motion of the steam inlet valve to the turbine, had been used to prevent the compressor tripping during recurrent repairs of the hydraulic control line on the governor system. This effectively disabled the over-speed trip. (See photos below).

At the time of the visit, the physical block had been left in situ, but the bypass was not recorded in the Bypass Register, and as far as we could make out was implemented without any approval. Also, the Permit-To-Work (PTW) documenting the last repair during which such unorthodox bypass was applied could not be found and staff recognized that, in the end, no PTW had been issued.



We Recommend:

- 1 To conscientiously rectify in the field the above described anomaly.
- 2 That no protective system bypass **of any kind** should be permitted without the appropriate assessment and approval, recording of the reason for the bypass, its time of application, time of removals etc, as required by the bypass register book and bypass control procedure. This must apply to software, key switch, hand-switch, jumper wiring, physical blocks, valve movements, wedges, or any other means whereby a system in whole or part is disabled.
- 3 That regular site audits be carried out to identify and correct any deviations from proper implementation of the bypass procedure and that personnel involved in such audits must be briefed on what to look out for in discovering unauthorised or unconventional bypassing activity.

Client Comment:

None Received

March 2012 Status:

- 1) **Closed:** The "block" on C351 governor, although highly irregular practice, did not disable the protection, which is independent.
- 2) **Closed:** Blue Book (recording and authorising of bypasses and their removal) appears to be properly used and authorised.
- 3) **Closed:** Regular audit is carried out on rotating machinery protection.

During the survey it was noted that there was considerable contamination in tank A7-2 (Cardon) with crude oil and water, originating from the tank water draw.



The reason given for this was associated with the piping system to the oily drain. It is apparent that the situation has persisted for a considerable time.

This constitutes a significant fire risk, noting that crude oil pipework and the floating roof seal pipework runs above ground in the contaminated area.

The above situation is reminiscent of recommendation 13.2007 (spill in Amuay crude tank 164 bund and nearby ground pipeway).

During the visit, we also noted various pipe trenches highly contaminated with oily mixtures, however in this case, there is an ongoing site wide programme to remedy this type of contamination.

We Recommend:

- 1 Urgent attention be given to the elimination of the cause of the contamination in tank A7-2 bund.
- 2 The contamination be promptly removed.
- 3 Audit the plants to identify similar instances elsewhere and diligently remedy them.

Client Comment:

None Received

1. **Closed:** The cause of this specific contamination – obstruction of a drain line – has been eliminated
2. **Closed:** Decontamination is completed. Photographs shown to the surveyors
3. **In Progress:** 2 other blocks of tanks (A5 and A6, distillates, not crude oil or black product) identified with similar symptoms. Planned to be treated, funds allocated.

The practice of bypassing fired heater and other protection systems during (threatened) electrical storm activity should be ceased – typically 18 hours, or up to 345h (see extract from one of the control room "Blue Book" below, used to record the overrides). Persistence of this undesirable practice, already noted at previous surveys, justifies the present recommendation.

Management of Change is also said to be not applicable, and mitigation by merely "monitoring constantly operational variables" over such a period is contrary to good practice, particularly with the staffing levels available. The consequent unavailability of the protective systems would certainly not comply with the required Safety Integrity Level.

ESTADO DE LOS SISTEMAS DE PROTECCION												
DESACTIVACION DE PROTECCION						ACTIVACION DE LA PROTECCION						
H/D/M/A	Unidad	Equipo	Tag del Item	Nombre y firma del Ejecutante	Nombre y firma del Autorizador	Causa desactivación del sistema protección	Medidas de mitigación	Nº MOC	H/D/M/A	Nombre y firma del Ejecutante	Nombre y firma del Autorizador	Fecha auditoría/Nombre y firma
23/00	HY-1	R-800	7-104	Daniel Pérez	[Firma]	CONDICIONES ATMOSFERICAS ADVERSAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	23/00	[Firma]	[Firma]	[Firma]
23/00	HY-2	R-800	7-103	Daniel Pérez	[Firma]	CAMBIO EN LAS CONDICIONES ATMOSFERICAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	07/10	[Firma]	[Firma]	[Firma]
20/09/10	HD-2	F-301	H115-S	Daniel Pérez	[Firma]	CAMBIO EN LAS CONDICIONES ATMOSFERICAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	07/10	[Firma]	[Firma]	[Firma]
23/00	HY-3	F-301	H001-S	Daniel Pérez	[Firma]	CAMBIO EN LAS CONDICIONES ATMOSFERICAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	07/10	[Firma]	[Firma]	[Firma]
20/09/10	HY-3	F-301	H007-S	Daniel Pérez	[Firma]	CAMBIO EN LAS CONDICIONES ATMOSFERICAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	07/10	[Firma]	[Firma]	[Firma]
23/00	HY-4	F-301	H001-S	Daniel Pérez	[Firma]	CAMBIO EN LAS CONDICIONES ATMOSFERICAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	07/10	[Firma]	[Firma]	[Firma]
20/09/10	HY-4	F-301	H007-S	Daniel Pérez	[Firma]	CAMBIO EN LAS CONDICIONES ATMOSFERICAS (TORRENTAS ELECTRICAS)	Monitoreo constante a las variables del proceso	N/A	07/10	[Firma]	[Firma]	[Firma]
17/05	HY-1	R-800	SIN EFECTO	[Firma]	[Firma]	MINIMIZADOS LOS SISTEMAS DE PROTECCION (BOMBIEROS)	SIN EFECTO					
23/09/10	HY-2	R-800	SIN EFECTO	[Firma]	[Firma]	MINIMIZADOS LOS SISTEMAS DE PROTECCION (BOMBIEROS)	SIN EFECTO					
10/10	HY-3	R-800	SIN EFECTO	[Firma]	[Firma]	MINIMIZADOS LOS SISTEMAS DE PROTECCION (BOMBIEROS)	SIN EFECTO					
30/09/10	HY-4	R-800	SIN EFECTO	[Firma]	[Firma]	MINIMIZADOS LOS SISTEMAS DE PROTECCION (BOMBIEROS)	SIN EFECTO					
10/10	HY-1	R-800	SIN EFECTO	[Firma]	[Firma]	MINIMIZADOS LOS SISTEMAS DE PROTECCION (BOMBIEROS)	SIN EFECTO					
01/10/10	HY-1	R-800	SIN EFECTO	[Firma]	[Firma]	MINIMIZADOS LOS SISTEMAS DE PROTECCION (BOMBIEROS)	SIN EFECTO					

We Recommend:

- 1 The root cause of the instability during electrical storms should be sought and remedied, rather than merely masking the symptoms by disabling the protective systems. (We suspect that the source of the problem lies in electrical equipotential grounding system).
- 2 "Management of Change" for important issues such as isolation of protection should always be considered, including when motivated by concerns over electrical storms,
- 3 Mitigation measures should be clearly detailed, and realistically achievable, stating alternative protective measures in place, or the parameters that must be monitored during the outage of the protective system.

Client Comment:

None Received

March 2012 Status:

1. **In Progress:** Cause has been identified to be the grounding of the protective system – improper segregation of the "Dirty" high current earth and the "Clean" reference earth. (this was our initial suspicion in 2010) Of 1387 "Varistors", 144 were found to be faulty and replacements are on order or being installed.
2. **In Progress:** Still some recent "Blue Book" entries of long duration bypasses for "Atmospheric Conditions" or "Rainstorms", even on units where it has not been a problem.
3. **In Progress:** Mitigation measures remain vague – "monitor the process" etc.

Several items of plant were seen isolated for maintenance purposes. It was noted that:

- Blinding/Isolation schedules and diagrams were not systematically used
- Valves were generally tagged but not physically locked.
- Electrical Isolations were tagged but not physically locked.
- Spades, blinds and blind flanges were not tagged.
- Terminal flanges were secured by less than half the flange bolts.
- Spades were secured between flanges by about half the flange bolts.
- On a specific reboiler maintenance job, it was not clear whether Spades had been inserted between flanges, or whether there was merely a spacer ring in place – there is indeed no system of identification of spades versus spacer rings.

(We are aware that this topic is under review by the Corporate multi disciplinary committee on Industrial Safety, and that a "Draft" procedure SI-S-28 was issued in January 2010)

We Recommend:

- 1 The use of blinding/Isolation schedules and diagrams on all but the most simple of isolation tasks, for all sources of energy and lubrication etc.
- 2 In addition to tagging, locking of all valves used for isolation. Full lock-out/tag-out is industry best practice.
- 3 In addition to tagging, locking of all electrical breakers used for isolation. Full lock-out/tag-out is industry best practice.
- 4 Tags to be attached to each and every blind, spade, spectacle plate or other means of isolation, cross referenced to the permit to work.
- 5 To establish a site standard for positive identification of "Spades" and "Spacers". A common convention is to use a robust "T" shaped lifting lug, with a hole drilled if it is a spacer, and no hole drilled if it is a spade. The shape of the spade or spacer tab should be unique and standardized throughout the site. The appropriate schedule/rating should also be stamped on the lug.
- 6 Where isolation spades, spectacle blinds, spacers etc are inserted between flanges, or terminal blind flanges are used, they should be secured using all the bolts, tightened in the correct order, to the correct torque. Stricter acceptance criteria should be adopted so as to ensure shortcomings like poor bolting practice no longer persists. In short, process isolations should have the same integrity as the system in which they are located.

Client Comment:

None Received

March 2012 Status: No Progress on all six points.

Full LOTO is not in practice. Dupont Training "Best Practice" has been taught, but is not practiced. The PDVSA Norm also calls for full LOTO.



Breaker with tags only



Pump Discharge – plate used instead of blind flange



Same pump – valves not tagged or locked.

The Fire Intervention Team keeps an annual "Plan de Trabajo" (work plan) in which is contained the schedule for firefighting exercises and preventive maintenance and testing of the various fixed, mobile and portable fire intervention resources. This appears to be a comprehensive and well formatted document, which if properly applied, would give the firefighters and management valuable and rapid information on the status at any time of the fire response capability and of the compliance with the planned testing programme. It is however only a "paper" plan, and is not incorporated into the "SAP" maintenance planning system. Also, many entries for past scheduled activities were noted to have been left blank in the work plan document, thus suggesting that the schedule was not being followed completely. Specific examples were the "Programma de Simulacro Año 2010", which listed monthly fire exercises, only the March 2010 exercise (Jetty #1) had been recorded, storage tanks bi-monthly protection testing, none recorded since May 2010, MTBE/TAME deluges and monitors, tri-monthly, only recorded in January and July 2010. It may be that the work is being done, and not recorded.

We Recommend:

- 1 The annual "Plan de Trabajo" should be incorporated into the maintenance planning system.
- 2 Compliance with the plan should be made a Key Performance Indicator for the Fire Intervention department and the work plan document should be maintained up-to-date.

Client Comment:

None Received

March 2012 Status:

1. *In Progress: Annual Plan is a local stand-alone spreadsheet/register, but work is entered into SAP when required.*
2. *In Progress: Early Days: "SICOINE" inventory and checklists etc. Are yet to be fully populated with all systems and apparatus. Only extinguishers, breathing apparatus, fire vehicles so far included. Needs to expand to capture all fixed and mobile systems of detection and protection.*

During the survey we requested a test of the deluge on Sphere 210 at Amuay, which has a single top deluge water distributor. During the demonstration, the "Sombrero Chino" (Chinaman's hat) water distributor at the top of the sphere detached, leading to a vertical fountain of water mostly missing the sphere. (see photo right)

A test of the deluge on Spheres E-01 & E-02 at Cardón revealed some blocked nozzles and some nozzles not properly pointing at the sphere, although the overall cover of deluge water appeared to be adequate. (see photo below)



These are the only deluges for which we requested demonstrations, and defects were noted in each case (although rather minor in the Cardón test case).

We Recommend:

- 1 That the "Sombreros Chino" of sphere 210 be promptly repaired and that the attachment arrangement for the "Sombreros Chinos" on other spheres at Amuay be inspected and any necessary remedial measures be taken.
- 2 That the cause of the blockage to the deluge nozzles at Cardón be determined, and remedied.
- 3 That the preventive maintenance programme for the sphere deluges be reviewed to ensure that proper attention is given to the function of the systems.

Client Comment:

None Received

March 2012 Status:

1. **Closed:** "El Sombrero Chino" has been replaced by a superior design, and other spheres also treated where necessary.
2. **Closed:** The deluge nozzles are reported to have been cleaned, scale flushed from the lines, and regularly tested. Any remediation is entered into "SAP".
3. **In Progress:** A paper plan for deluge tests and routine maintenance exists since 2011, being migrated to "SICIONE" See 07.2010 above.

Emergency Isolation Valves are operated in some cases from the control bunker and locally by hand-switches on the units, and in others solely from pushbuttons with indicator lamps on the units. These pushbuttons and lamps are located around concrete columns, potentially in positions at risk from plant incidents. They are poorly labelled and not at all "obvious". There are also issues of integrity such as damage to indicator light, missing indicator light bulbs etc.

In our opinion these critical protection devices might be difficult to locate in an emergency, and once located, the appropriate pushbutton might not be immediately apparent (see photographs below)



We Recommend:

- 1 The safe location of EIV pushbutton stations be reviewed in the context of risk from process incidents.
- 2 The EIV pushbutton stations be clearly designated, by means of conspicuous colouring of the concrete column on which they are located.
- 3 That each individual EIV pushbutton module be clearly identified by tag number and the equipment served by the EIV.
- 4 That all EIV pushbuttons be regularly tested and maintained in optimal operable conditions.

Client Comment:

None Received

March 2012 Status: Closed: All 4 parts.

At Cardon, pillars identified by Yellow Paint, with push-buttons labelled by stencil. >>>>>

At Amuay, new motorised valve panels have been installed in some units, installation continues in turn-arounds. (below)



"SILCO" is PDVSA proprietary inspection data management software used for corrosion monitoring and predictive inspection scheduling.

It was noted that in the "SILCO" database, there were many instances where there had been no recorded change in the recorded piping wall thickness for two or three measurement cycles. It was explained that where a reading greater than the previous record was obtained, the previous value was retained, rather than recording the measurement taken. This is despite "SILCO" automatically issuing a recommendation to check the reading whenever a reading larger than the previous recorded value for the same measurement is input.

The cause of the higher reading could be calibration error, operator error, non-repeatable measurement points, recording error, or the (in our opinion more likely) possibility that the previous reading had in fact been erroneously made and recorded as a lower than actual value.

The consequence of such instances is that the rate of corrosion is either not possible to calculate, or if calculated, might be lower than actual, leading to potentially unsafe errors in the estimation of remaining life.

We Recommend:

That whenever an anomalous wall thickness reading is observed, whether it be larger than the previous value, or not in accordance with the existing Trend: of change in the wall thickness, the measurement be checked by repeating the measurement using the same measurement instrument and a second measurement instrument that has been check calibrated. This should preferably be done by a senior inspector.

Client Comment:

None received

March 2012 Status: In Progress, although not much apparent

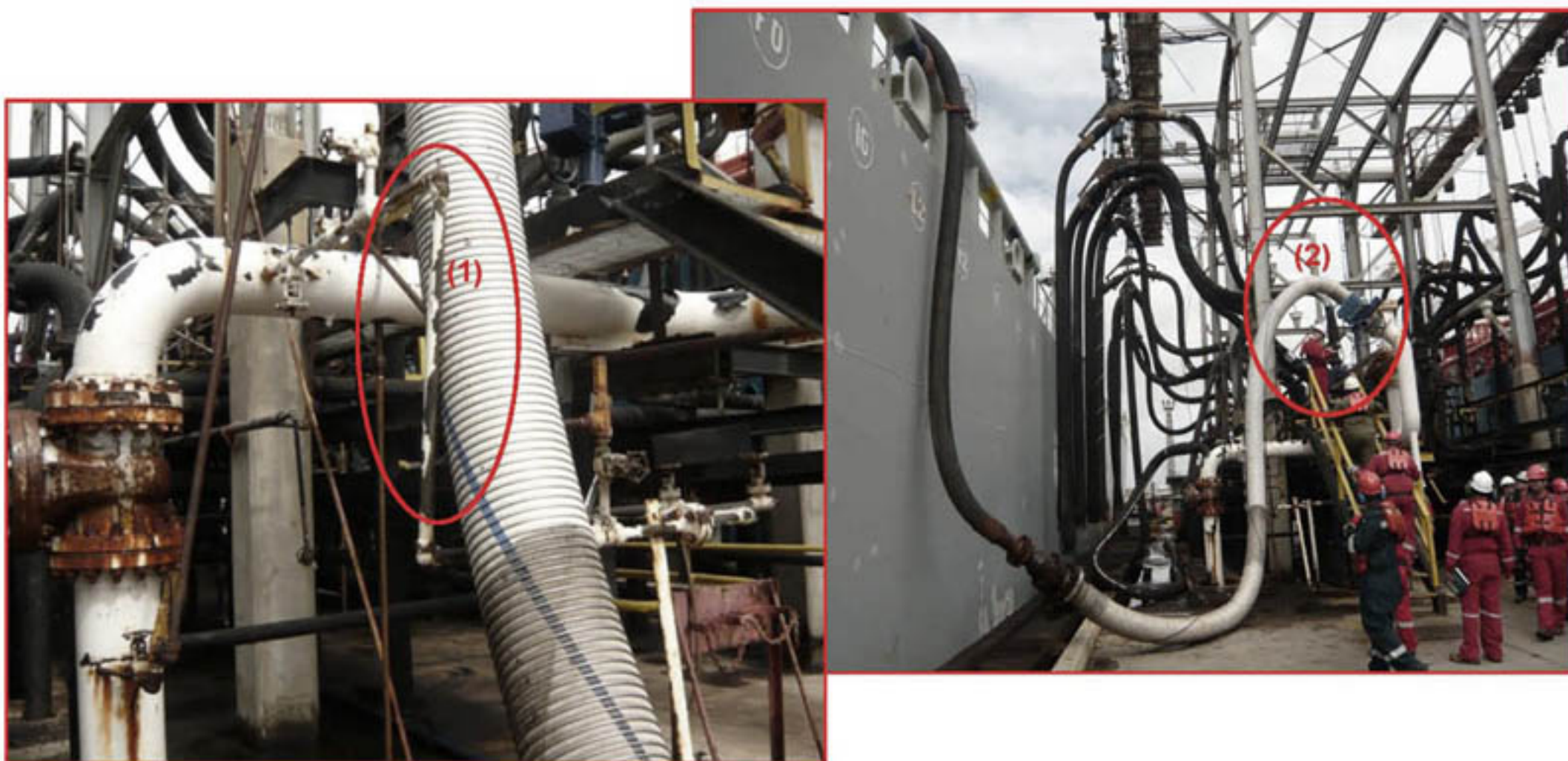
Although it was explained to us that the problem arises only where there are small differences in readings, it is important to realise that the principal of assuming that the previous reading was "correct" is not satisfactory. (symptom – apparent increase in wall thickness)

13. Observations

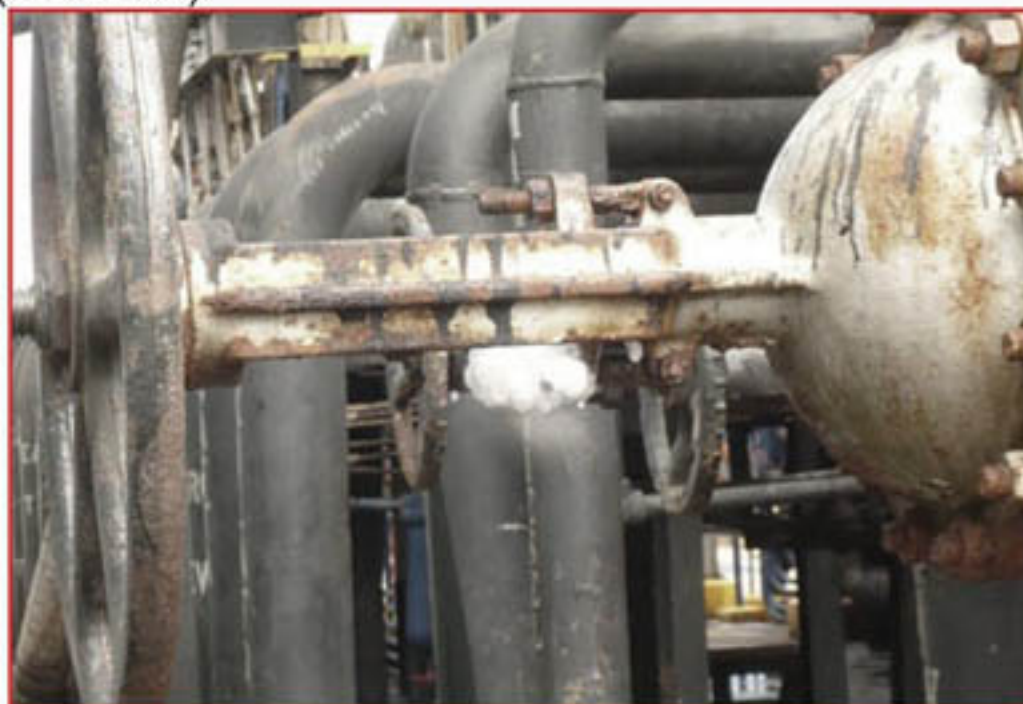
The following observations were made to the Management of Centro de Refinación Paraguana, mainly during the close-out meeting. It was not our purpose to make new recommendations, although CRP management were encouraged to act on these observations.

Unsafe Conditions at Amuay Jetty 3.

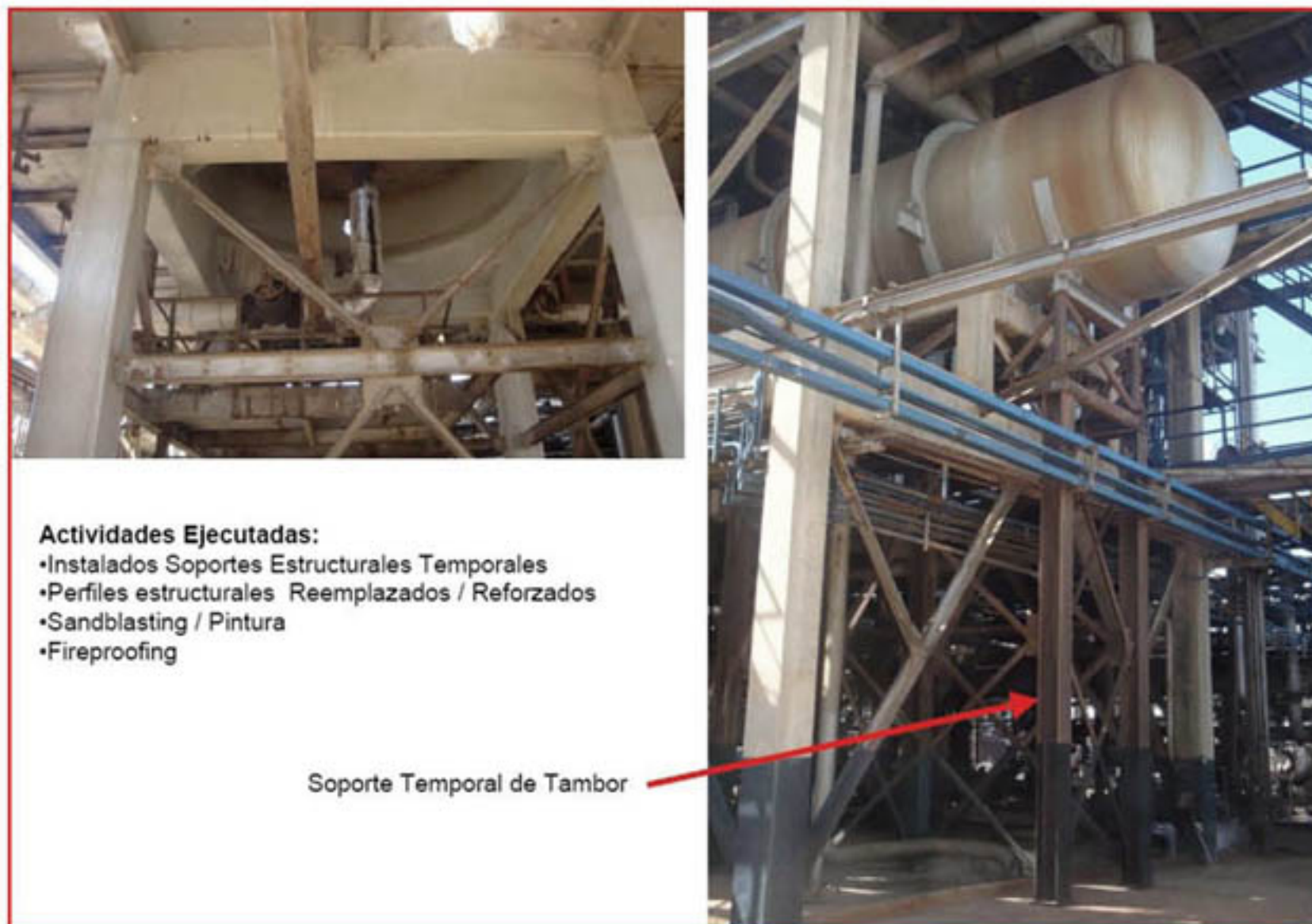
We noted an instance of a (heavy) hose bearing on a small bore relief line (1)— on LPG duty. (see below). This line serves both a thermal relief valve and a Nitrogen Purge point. It is also noted that this LPG line uses no hoist, and that there is an unsupported small radius bend, which must act as a significant stress raiser. (2)



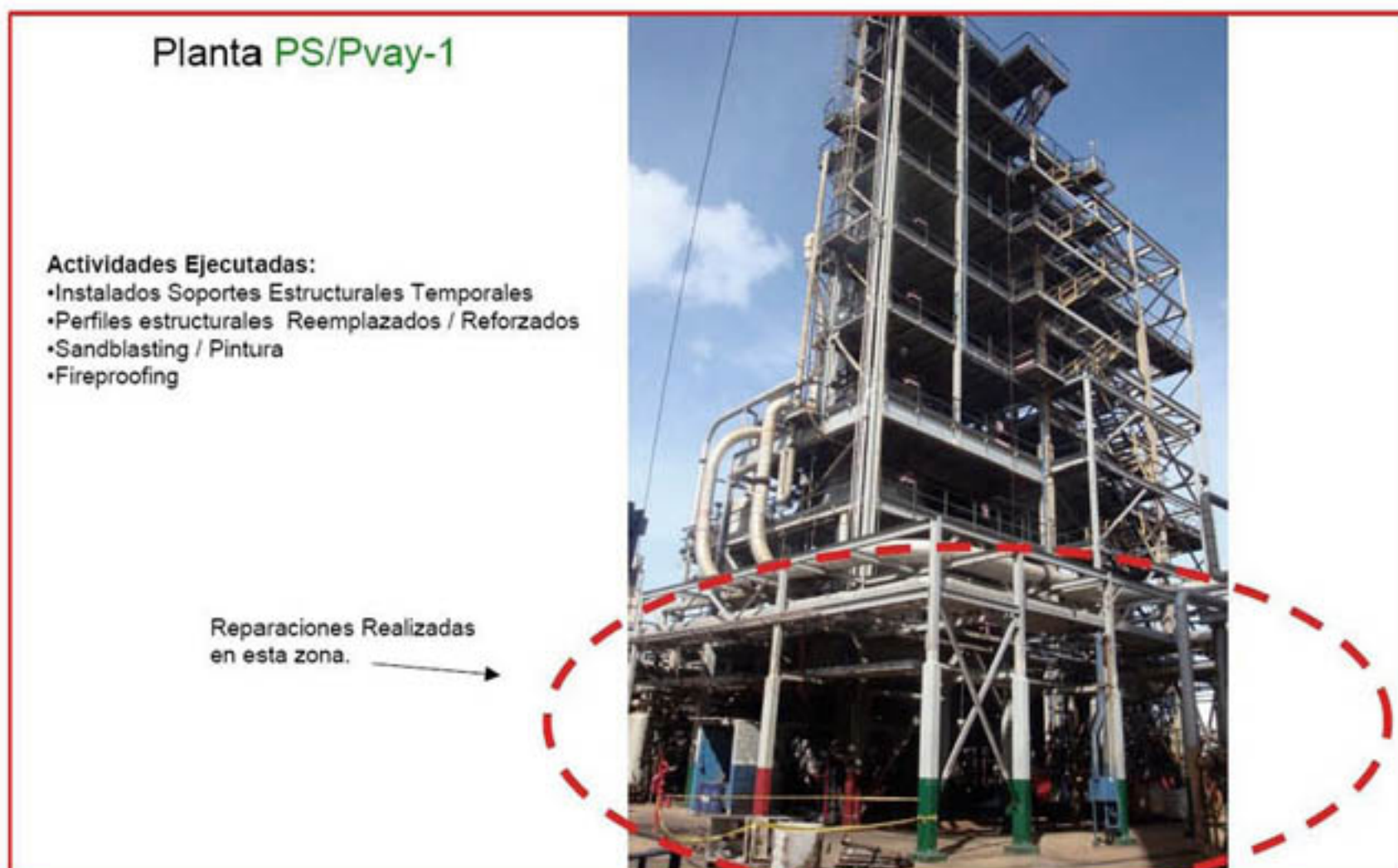
Two LPG leaks were also noted on the same system, one on the Nitrogen Purge Point, and one on a valve packing (see below).



Structural Integrity Programme – good evidence of progress, but a long way to go.
These pictures from Amuay PS/PVAY1



The "Soporte Temporal" was installed to allow operation to continue until the structure was renovated. Note that it was not fireproofed, hence the structure was not effectively protected against failure during a fire. The renovated structure restores the necessary fire-proofing. Note also that the repairs (temporary and renovations) were carried out as "SIMOPS" - i.e. on the run.



Much still to be done, especially at Amuay



Structural Fireproofing on the structure of PSAY4, advanced degradation of structural fireproofing – to say nothing of the probable condition of the steelwork it encases.



New Structural Fireproofing on supports to feed to atmospheric column.



PVAY-4 Vacuum Unit, Compromised structural fire protection and temporary support in place pending repairs to structure.

Vacuum Bottoms Line – pipe hanger from unprotected beam, bolt on support clamp not secure, no catchbeam, and as yet, no EIV on column bottom.



PVAY-4 Corrosion under Insulation There is a programme to remedy this.



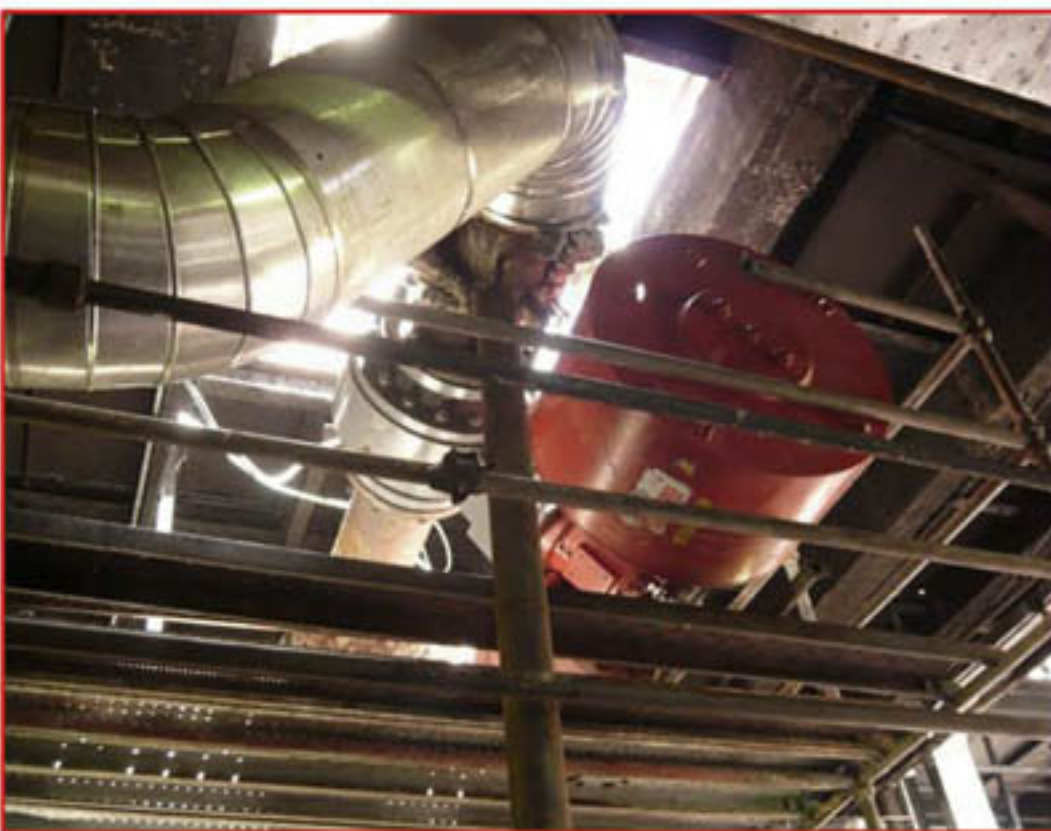
Cardón CD-4 Fire Repairs



Highly congested and confined area of pumps, re-bars exposed by concrete spalling on underside of upper (exchanger) deck, not clear when (if) these are to be repaired.



New pipe supports - not fireproofed.



Emergency Isolation Valve added to base of column.

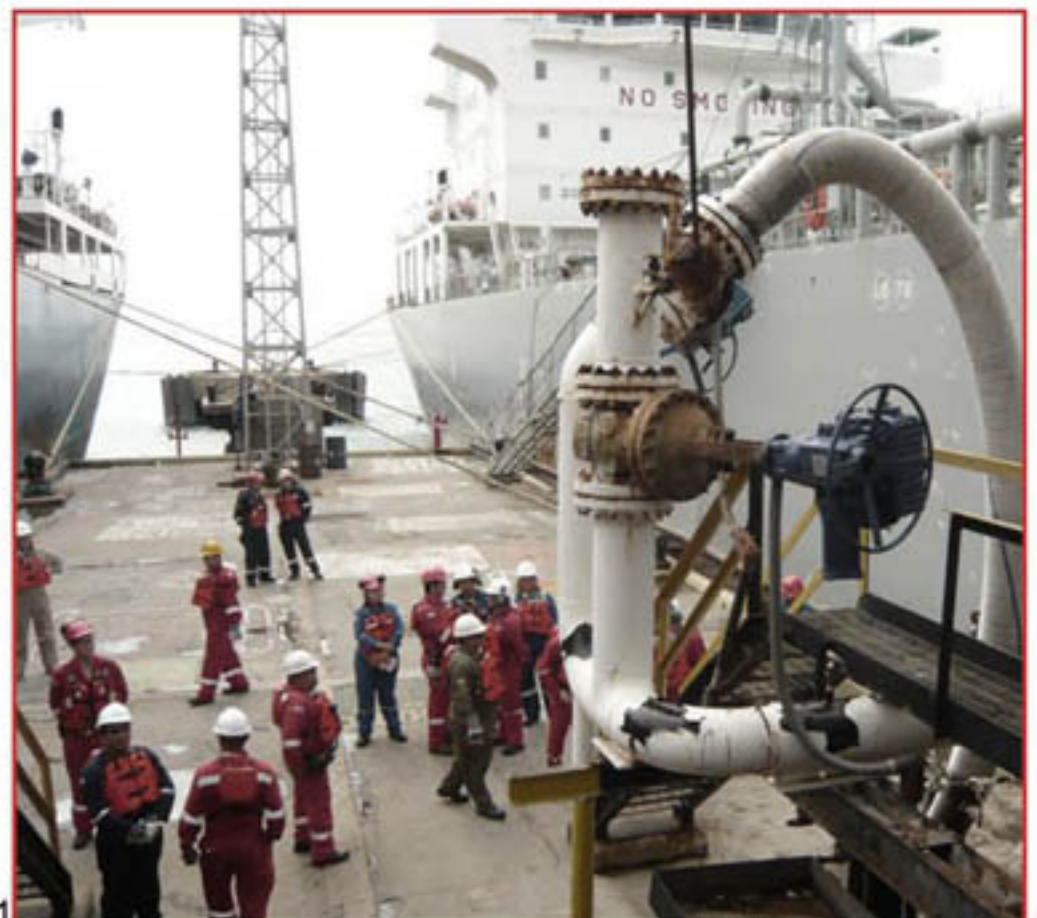
Jetties

Amuay Jetties: Compact, Congested, incident on one likely to affect neighbour, in addition to the vessel on the adjacent berth.



Hose handling Gantry – LPG hose (nearest) has not been supported by hoist. LPG line has motorised valve, locally operated.

Relatively narrow jetty, ships close together.





Manifold valves for most products are manual.

Adjacent jetty 4 has Chicksan Arms rather than hoses. Recently upgraded.



There are 2 clamps on the Kerosene line, to be eliminated at next TAM in 2013



Many clamps on fire-water line, being replaced now (see new pipes)

Cardón Jetties: Well separated, ships berth both sides, wider access ways and jetty heads than at Amuay.



Mix of hoses for white products and articulated arms for LPG



Complex manifold, some motorised valves, most manual.



Emergency Isolation valve, failsafe, (air to open, spring to close) some confusion about tag nº, fireproof cover not replaced, actuation from local switch only.





Foam solution manifolds and air venturis for under-deck foam curtain

Remote operated steerable elevated foam/water monitor.



Hose with split outer vulcanised layer, and hose to replace it. (see test date on hose)



Jetty 1 Repairs



Under-deck structure extensively replaced



Temporary supports welded to original steel structure, resting on new concrete sub-structure while concrete replaced.



Substantial sections of Upper Hose Handling Structure replaced.