The Implementation of Effective Key Performance Indicators to Manage Major Hazard Risks

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Company Background

ScottishPower/Iberdrola

ScottishPower was formed in 1990, through the privatisation of the previously state owned Scottish electricity industry. ScottishPower was formed for the most part, from the larger of the two Scottish electricity boards, the South of Scotland Electricity Board.

ScottishPower is a vertically integrated energy company with its headquarters in Glasgow and is involved in the generation, transmission, distribution and supply of energy to customers. The generation sites currently have an installed capacity of 6GW and includes Coal, Gas and Hydro Power Plants and 1200MW of on-shore wind generation with the number of customers around 5 million.

In April 2007, ScottishPower was acquired by the Spanish utility company Iberdrola.

IBERDROLA has undergone a wide-ranging expansion and growth project over the last ten years which has enabled it to become a multinational company, present in more than 40 countries. The number one Spanish energy group, the fifth largest company on the IBEX-35 by market capitalisation, the world leader in wind energy, and one of the world's five top power companies.

After more than 109 years moving forward, the Company has now laid the firm foundations for its future growth across the following business areas: Regulated business; Liberalised business; Renewables, Energy business and other business.

IBERDROLA USA from New York to Maine, Iberdrola USA delivers natural gas and electricity to nearly three million customers across two states.

IBERDROA Renewables USA is the second-largest wind developer in the US, with more than 4,727 MWs of operating wind farms and a 24,500 MW development pipeline. We have 621 MWs of operating gas-fired thermal generation; and both biomass and solar power projects are under development.

Process Safety Approach

ScottishPower (SP) was able to transform its organisation into a leading global exponent of process safety and asset management. In 2009 the company became the first power generator to be certified to BSI PAS 55: 2008 (PAS 55); in 2010 the Institution of Chemical Engineers recognised the company's achievements by awarding it first prize in the IChemE 2010 category of innovation in process safety; and, in 2011 it became the subject of one of the first case studies to be published jointly by the UK Health and Safety Executive (HSE, 2011).

A number of high-profile, international incidents have demonstrated that concurrent failures in the areas of people, processes and plant can cause catastrophic plant safety failures. In response, the UK Health and Safety Executive (HSE) developed an approach to process safety management to help organisations operating in hazardous sectors to demonstrate adequate risk control.

At the outset of the project it was realised that the desired approach to process safety could only be successfully delivered and sustained through the development and integration of the current and required new IT systems. To achieve this, Amor Group, one of the leading providers of business technology solutions to the Energy Sector, was identified as a strategic partner to assist in the development and delivery of the underpinning IT strategy including the development of the Process Safety KPI Dashboard and associated core IT systems. Of particular importance was the work delivered by the Amor Group in automating the KPI management process, as this automation has allowed the dashboard to pull data directly from the underlying business system and update the status of the KPI's on a daily basis and risk rank them without adding any reporting burden to staff. It has also meant that staff have a greater level of trust in the KPIs that are produced as they know it has not passed through lots of sets of hands before the whole business gets to see the results.

The Process Safety KPI Dashboard with the automation of KPIs has been so successful that this approach is now been offered as an off-the-shelf solution by the Amor Group to the Major Hazard Industry. And the partnership between ScottishPower and the Amor Group endures to this date.

SP embraced this approach through its Operational Transformation Programme (OTP) which aimed to make it an industry leader in process safety and asset management focused through the delivery of a "High Reliability Organisation"

Key thinking was developed to answer the following questions:

What if Process Safety risks were as visible as Health & Safety risks?

Which warning signs are most likely to help you avoid an incident?

Fig 1 Shows the concepts which are based on making process safety risks visible to the organisation.

Fig 1 Process Safety Signs

Establishing the Key Performance Indicators, KPIs

To deliver the process safety management system, and specifically to establish a comprehensive set of leading and lagging process safety performance indicators, ScottishPower followed the UK Health and Safety Guidance on establishing process safety performance indicators (HSG 254.)

A multi-functional team from the business (including key contractors where processes were undertaken by external staff) followed the six stage approach in HSG 254 to identify 90 Hazards/Hazardous Events and the 42 Risk Control Systems (or "preventative barriers") that are required to manage these hazards. The team then reviewed each risk control system to identify one or more leading indicators, crib sheets were used to capture detailed specifications for each KPI. Whilst the process covers a range of power plant technologies it was found the majority of leading indicators could be applied but different targets and tolerances were set according to the power plant type and risk. In total 100+ Leading Indicators were identified across all Risk Control Systems. This is shown in Figure 2.

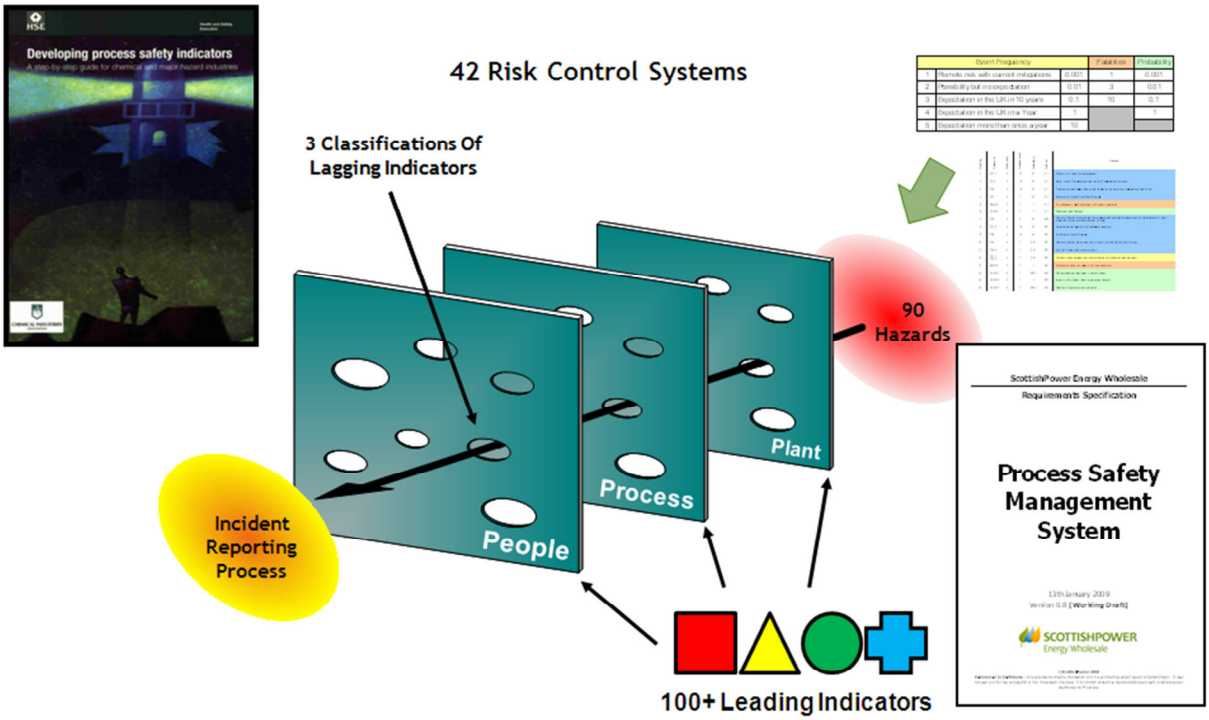


Figure 2 - Risk Control Systems Principles

It was clear that 42 Risk Control Systems and the associated 100+ Leading Indicators was too large a data set to present meaningful information to the management team so the 42 risk control systems were nested into 8 headline Risk Control Areas to form the basis of the Process Safety Management Dashboard that covers:

- Operational and Compliance Audits;
- Technical Risk Management;
- Staff Competence;
- Operational Management;
- Maintenance Management;
- Critical Systems Management;
- Alarm and Instrument Management; and
- Emergency Preparedness.

Figure 3 shows how this was collated into a formal management system in terms of Risk Control Areas.

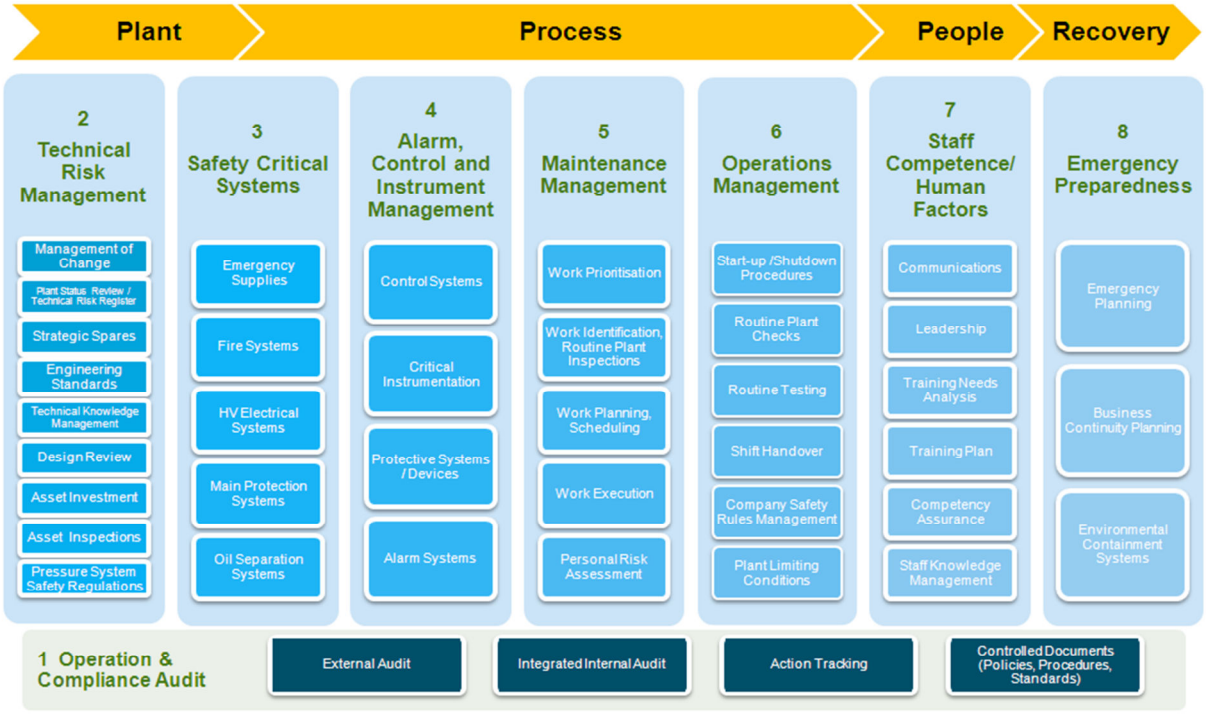
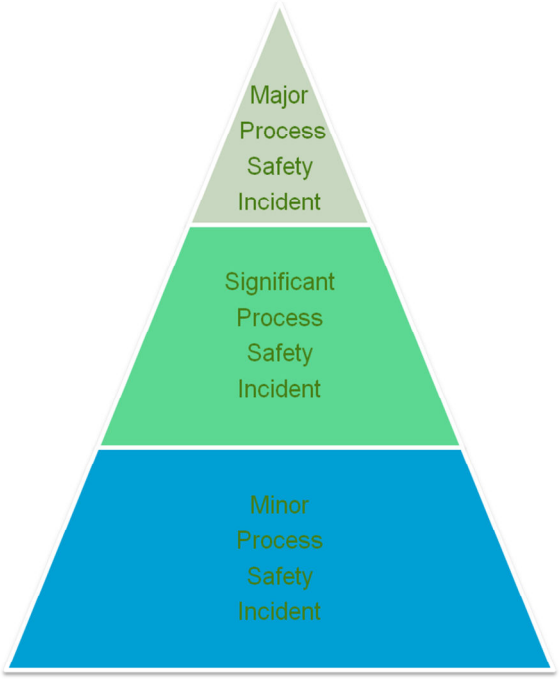


Fig 3 Risk Control Area Model

In terms of Lagging Indicators, ScottishPower took a simple view that incidents and near misses were the single source of Lagging Indicators. To capture this lagging data, a new incident management process was implemented to capture and drive out consistent investigation of root causes. To ensure staff report process related incidents and near misses a major cultural awareness programme was developed which trained staff on the importance of the role that "lagging" indictors play in learning from events and preventing such incidents occurring again across the Iberdrola fleet. Further to this a companywide Technical Incident process has been developed.

To ensure all incidents and near misses are recorded the incident management system was modified to make it very simple for any member of staff or contractor to report an incident on line. Further to this automated reporting of process incidents was included in the development plan for the dashboard such a process excursions or limits being breached (e.g. tank level). A key part of this process was also to classify incidents as major, significant or minor (based on API 754 – Process Safety Performance Indicators for the Refining and Petrochemical Industry) and to relate them to one or more of the underlying 42 Risk Control Systems that failed this is defined in Figure 4.



Classification of Process Safety Incidents based on benchmarking with HSE and API guidance:

- **Major Process Safety Incident:**
  - Equipment damage > £100k
  - Loss of Production > 24 hours
  - Injuries / fatalities (RIDDOR)
  - Major environmental impact
- **Significant Process Safety Incident:**
  - Equipment damage > £20k but <£100k
  - Significant release of energy or hazardous matter
  - Fire and explosions
- **Minor Process Safety Incident:**
  - Demand on safety system
  - Process upset – control loops out of control, equipment in manual
  - Breaches of plant limiting conditions

Figure 4 - Process Safety Lagging Indicators

To improve performance and track trends a system of simple colour coded targets were set for each KPI. Blue shows where performance meets a level that is considered industry best practice. Green indicates performance is on target, amber that it is within acceptable tolerance and red to shows where it is below acceptable. Both "leading and lagging" indictors are brought together to build a live "Swiss Cheese" model approach. The key focus is always on leading indicators as these are more predictive in terms of preventing a major accident. This was then developed into a visible PSMS to allow the RCS barriers to be measured daily; this is shown in Figures 5 and 6

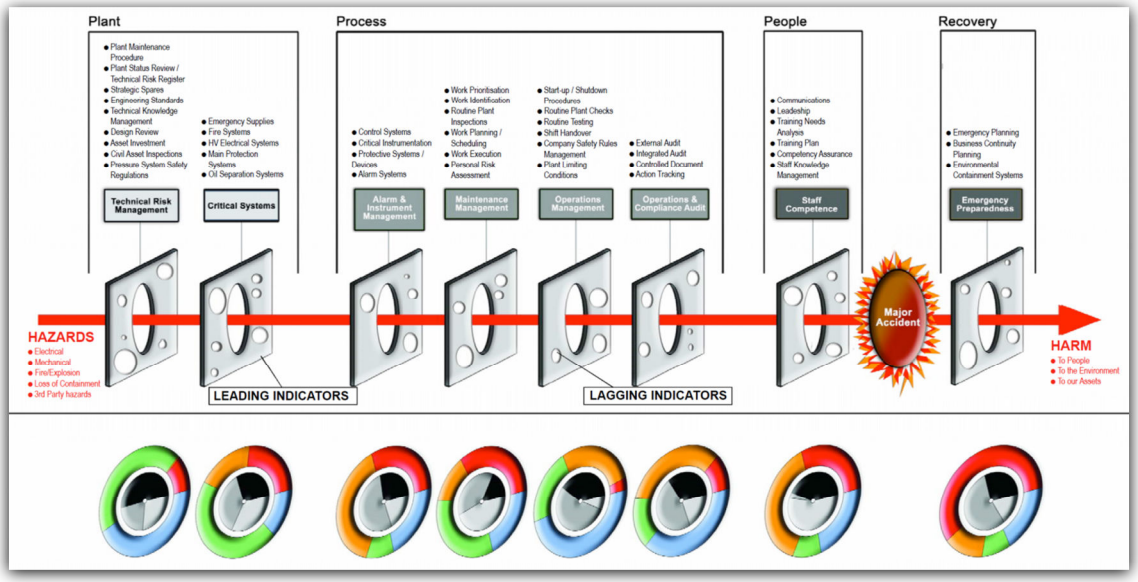


Figure 5 Risk Control Barriers

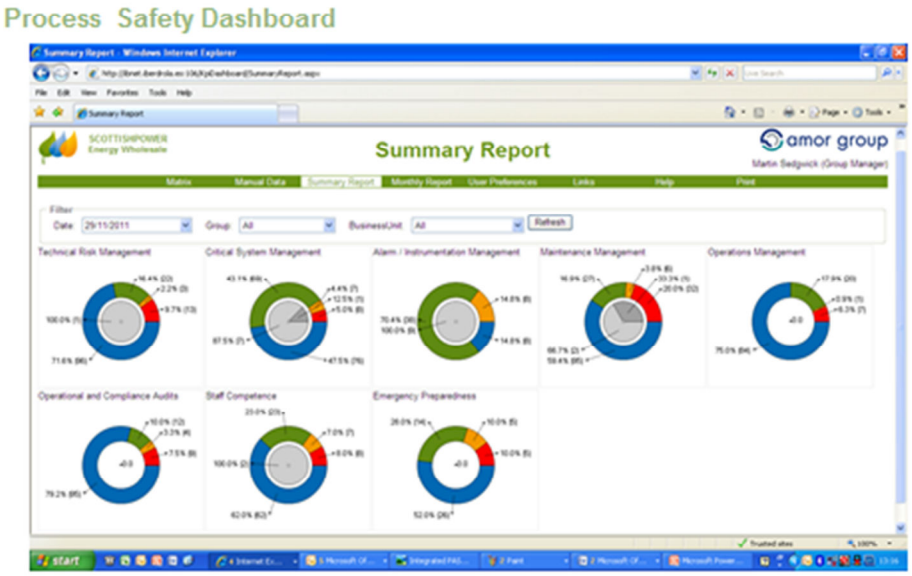


Figure 6 - PSMS System Live view

Risk Ranking of KPIs

A key concept of the approach is that not all indicators are of equal importance when considering predictability in terms of risk. Three types of indicators were identified, Operational Control, Generic and Programme Indicators. In terms of preventing a major incident or accident it is the Operational Control Indicators that need to be focused on.

Many organisations have process safety key performance indictors based on programme and generic categories as often these are easier to measure. Whilst these indicators are important in terms of setting leadership and culture they are very rarely involved with the initiation of a process safety incident or event and are often over measured and can give a false sense of security that risks are being managed. Operational Control Indicators are often under collected due to the complexity of requiring some real time data to be transformed into relevant KPIs but are the key to preventing future incidents. The types of indictors in each group are summarised below in Figure 7:

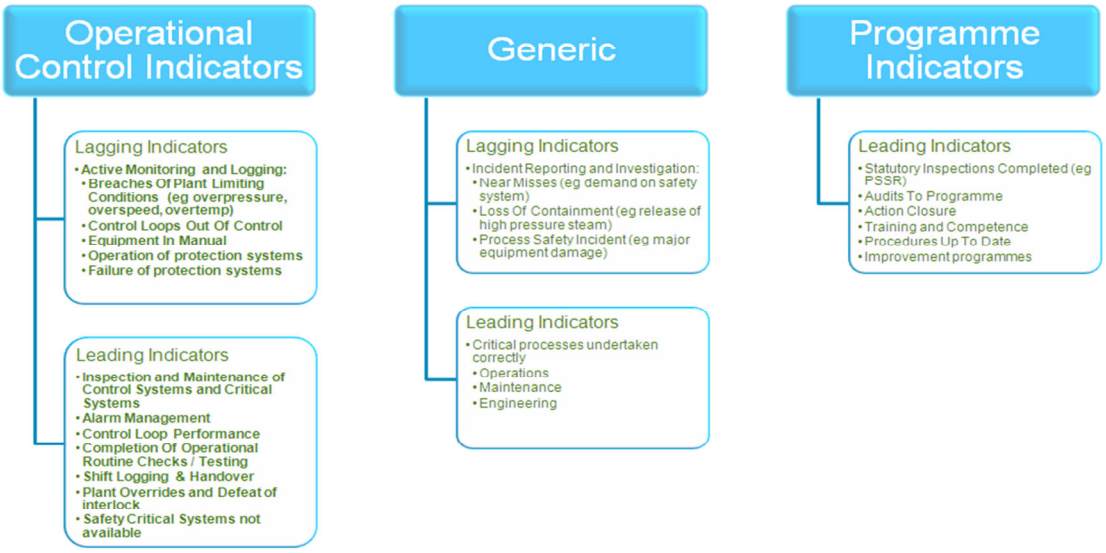


Figure 7 Types of Indictors

Having recognised the categories of KPIs a risk model was developed which allows the important KPIs to be easily visible to the organisation. The KPI dashboard was then developed to take these concepts into the governance and management process of the individual indicators and power plants. Figures 8 and 9 shows the concepts:

Figures 8 and 9 Risk Ranking of Key Performance Indictors

Key Hazard Report

Once the KPIs have been developed linking key hazards to risks then it is a simple task to provide hazard reports and the condition of both preventative and mitigation barriers. Preventive barriers are those leading indicators which prevent and predict an incident such as corrosion inspections and mitigation barriers are those leading indicators which reduce the impact of an incident such as the availability of a main protection or shutdown system. This is shown in Fig 10.

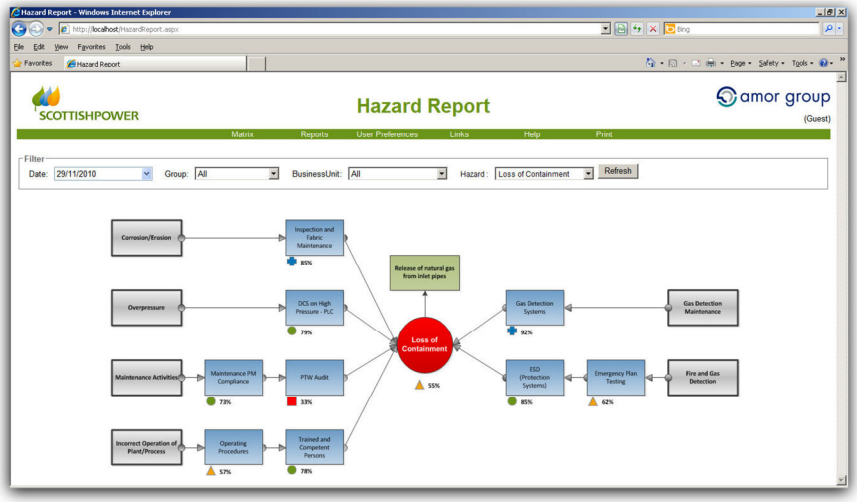


Figure 10 Hazard Report

Prevention of a Major Accident Hazards

To prevent a Major Accident Hazard the key performance indicators need to be visible to all in the organisation from the operator or maintenance technician up to the CEO level. These indictors then need to be acted upon throughout the organisation and seen as the driving force behind the business in terms of reducing safety risk and improving performance and efficiency.

To make this happen the indicators are made visible to all employees of the company, including contractors through the use of the intranet and daily discussions with staff. This is achieved by proving the dashboard with a number of features such as drill down to individual pieces of work, trending and reporting screens. To ensure no indicators are missed through data aggregation etc. red indictors at a plant level will feed through as red to the top of the organisation but the risk ranging process allows the focus to be on those indicators which are of most significance. Figure 11shows a number of screen shots used by the organisation.

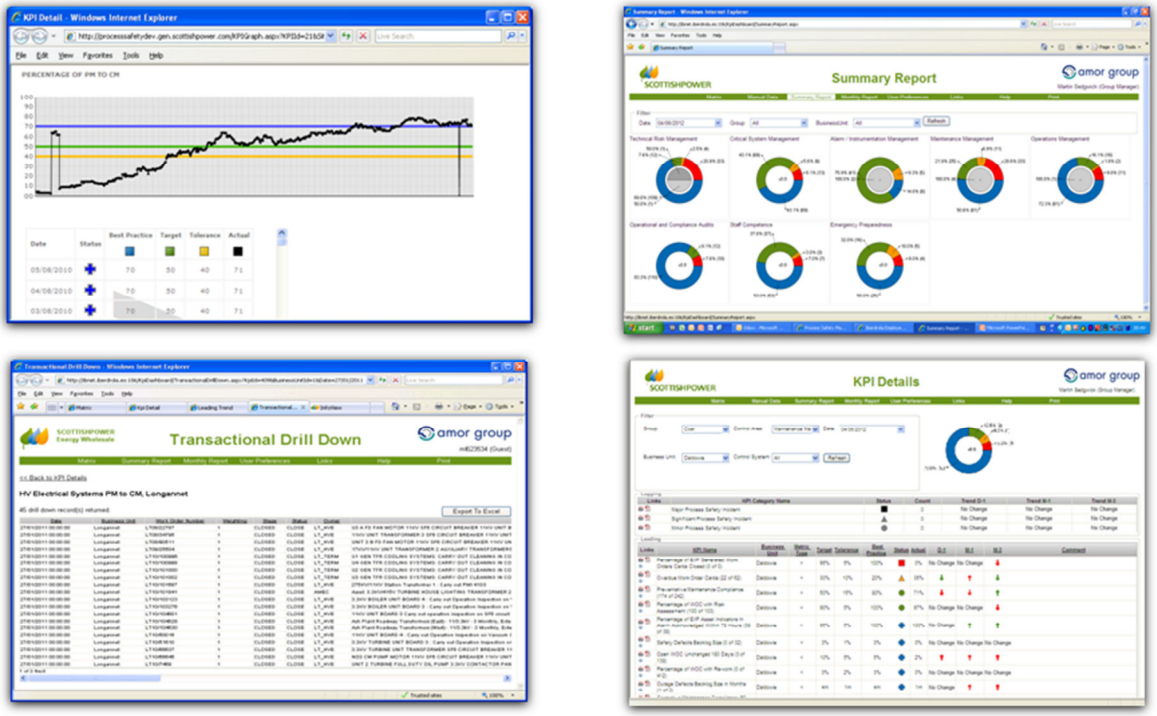


Figure 11 Dashboard Screenshots

Integration & Automation Of PSMS

An effective IT strategy and system lies at the heart of ScottishPower's success with process safety management. A significant amount of ground work had been performed in 2006 through to 2008 to consolidate the business on a small set of "best of breed" applications. These applications provided a robust and automated source of data required to derive the leading KPIs on a daily basis. Rather than having lots of different KPI reporting systems ScottishPower chose to adopt a unified approach that has eliminated any conflict over data collection.

The smart use of IT – including the use of hand-held data loggers – means data management systems are integrated into process plant and other 'day-to-day' operational systems. This enables the company to drill down through each headline KPI to reveal the underlying transactions, assess near-time performance of each generating station and to see trending information and progress towards the agreed targets. What this also allows is accurate benchmarking between the company's other comparable assets. The information is available to everyone in the company at anytime enabling identification and the ability to act upon problems within the system before it affects business and safety. Figure 12 shows the concepts.

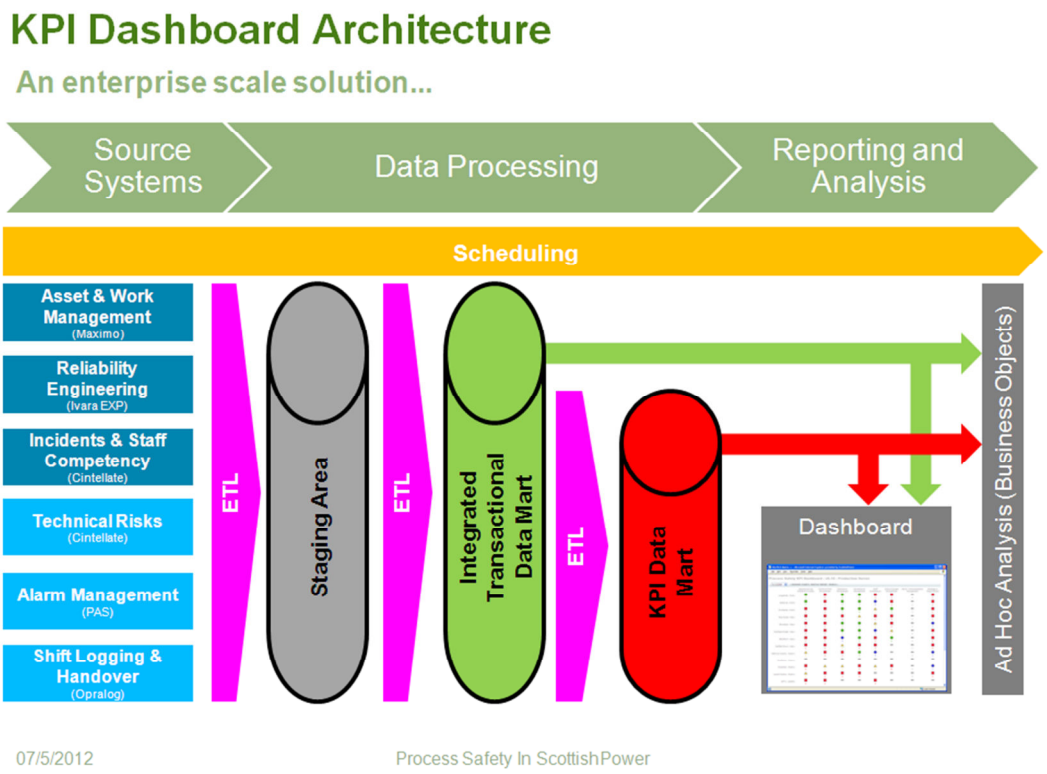


Figure 12 Automation Concept

Review & Governance

The company's Process Safety KPI Dashboard was a key outcome from the process safety programme. This monitoring and reporting tool was developed following rigorous, practical application of the HSE's guidance on process safety indicators (HSE, 2006) and delivers the following capabilities:

- Near-time visibility of leading indicators for key risk control systems across all power stations – providing 'at a glance'" assessment of plant condition and the performance of key processes;
- Improved reporting of incidents and near misses, enabling information to be shared more widely and repeat incidents to be prevented;
- Provision of timely, accurate and comprehensive information to support the governance of process safety through early identification and proactive management of risks;
- A governance framework to ensure that performance and actions are reviewed on a monthly basis.

The dashboard provides directors with information that had not previously been visible. Some staff and contractors felt uncomfortable that detailed information on processes in which they were involved had become so visible. Leading and lagging indicators are a major source of performance information, supplemented by other information such as the Asset Risk Framework, management reviews, audits - against business engineering standards, PAS 55, IS0-14001, OHSAS-18001- accident and incident investigations and benchmarking.

The organisation had to work hard to respond constructively to some of the information that was being presented. The key outcomes were a better appreciation of the underlying causes of process safety issues and the action plans being put in place to resolve them; and a company-wide focus on tracking actions and seeing the performance improvements coming through onto the dashboard.

It is the visibility and governance framework that has allowed leaders to own and drive the programme and to deliver business improvement. SP set up a Governance schedule that drives regular reviews of process safety performance information at all levels in the business to identify trends and initiate the proactive actions required to prevent plant related incidents. Governance takes two forms:

- Formal Governance – regular review meetings are scheduled at all levels in the organisation from facility level up to the SP Board to establish ownership and accountability for process safety management. The information that drives this process is fully transparent so all staff can play their part in improving performance.
- Our Culture – alongside the formal governance process, all staff are required to understand the hazards and risks evident in everyday operations and report and challenge any concerns they may have about process safety. This culture is described as maintaining a 'chronic sense of unease'; to ensure people are always thinking about what could go wrong and never complacent.

Ongoing Development of Process Safety Indictors

The ongoing development of process safety key performance indictors has been shaped by the review of major process incidents led by regulators in proving a framework. A number of industry bodies have also provided guidance for specific industries to help frame thinking on the subject.

The most difficult part in developing indictors is the actual transformation of a concept on paper to a real and relevant practical, ideally automated approach that reduces the burden of reporting on the organisation. To ensure compliance with the requirement to report effective indictors a government oversight or regulatory guidance framework needs to be established.

The development of the identification and definition including the collection and use of indictors to prevent a major accident requires to be driven by Industry and Industry bodies to help define a more detailed approach with a focus on "Operational Control Indictors". The smart use of IT systems and integration are essential and critical success factors and should not be overlooked in finding an effective, sustainable solution for process safety performance indictors to prevent future major accidents.