DELIVERY OF A GLOBAL CONTROL OF WORK SYSTEM

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This Paper defines the requirements for a consistent approach to Control of Work in BP Lubricants blend plants. It then describes the selection of an electronic application appropriate to the level of risk at these plants; the implementation programme that was adopted; the procedure used to ensure that it was fully accepted by site staff; and the benefits obtained and lessons learned from its implementation.

INTRODUCTION AND BACKGROUND

BP Lubricants develops, manufactures and markets lubricants and associated products for automotive, industrial, aviation, marine and power generation applications. It operates in 60 countries and has an annual turnover of about £15 billion.

Its Global Supply Chain (GSC) operates 33 blend plants worldwide, producing around 3 billion litres of product per year. These plants have a variety of heritages: Castrol, Mobil, BP and some smaller businesses purchased by these companies over the years. The history of the plants is one of relatively autonomous operation within a country-based business, with few common working practices and procedures. The facilities came together at the beginning of this decade when BP acquired Castrol, and are now run on a more integrated regional and global basis.

The age of the plants varies from 1 year to almost 90 years old, and they typically employ between 50 and 150 people, both full-time BP employees and contractors. Staff at all levels are almost always taken from the location country. Processes involve the bulk storage, transfer, heating, blending, packaging and storage of hydrocarbons and similar materials. While both the raw materials and finished products are generally of low hazard, several sites handle potentially flammable or otherwise hazardous materials such as those used in industrial applications for metalworking and corrosion inhibition.

English is the business language of the Company, and generally spoken proficiently by plant management. However, this is less common among operations and maintenance personnel.

CONTROL OF WORK

WHAT IS CONTROL OF WORK?

The term Control of Work covers the means of safely controlling construction, maintenance, demolition, remediation, operating tasks and similar work activities. It comprises a number of elements, all of which should be applied to ensure good Control of Work practice. These can be summarised in the flow diagram shown in Figure 1 which shows the steps to be taken when planning and executing a piece of work.

Control of Work not only covers non-standard or unusually hazardous work, but also standard procedures and practices. This paper deals principally with the process of preparing, issuing and managing Work Permits for hazardous and non-routine tasks. However, it is a requirement of good Control of Work that all activities at a site, even those that are routine in nature, shall be properly controlled by carrying out and documenting risk assessments, developing formal operating procedures, and ensuring that staff are properly trained.

FACTORS CONTRIBUTING TO WORKPLACE INCIDENTS

Most workplace incidents can be attributed to a number of small events occurring in sequence, leading to a much larger event. The use of proper Control of Work procedures can significantly reduce the likelihood of these smaller incidents developing into a major one. Figure 2 is a well known illustration of how a number of barriers can be put in place to prevent a Hazard or Risk leading to an Incident. If there are flaws in these barriers, such as inadequate risk assessment or energy Isolation, a path can be opened up from the Hazard to the execution of the work. If there are flaws at all stages of the process there is a real risk that this path can lead to an undesirable outcome.

WHAT IS A WORK PERMIT AND PERMIT PROCEDURE?

An effective Control of Work procedure requires that a Work Permit shall be obtained before conducting any non-routine hazardous activity. Such work could involve confined space entry; work on energy systems; ground disturbance; hot work or similar activities.

Before carrying out any work of this nature, a Permit to Work must be prepared that:

- Defines the scope of work and its duration
- Identifies hazards and assesses risk
- Establishes control measures to eliminate or mitigate hazards
- Links the work to other associated work permits or simultaneous operations
- Is authorized by the responsible person(s)
- Communicates above information to all involved in the work
- Ensures adequate control over the return to normal operations.

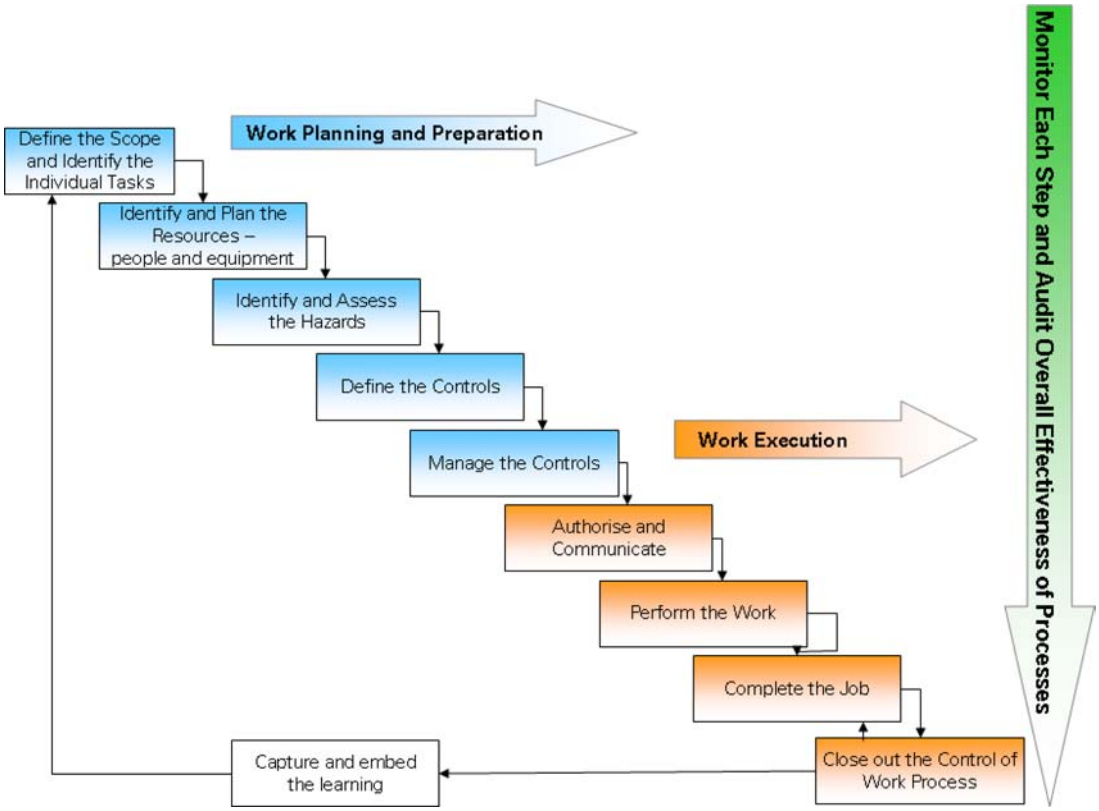

Figure 1. Control of work process flow

The Permit to Work provides written confirmation that all these steps have been carried out and that appropriate control measures to protect personnel and equipment from each of the hazards have been provided. It is a formal agreement between the permit authority (responsible person) and those who will carry out the work that both the risks and the controls that will mitigate them are understood and that the controls will be fully implemented.

Existing Practices and Need for Improvement

Until 2003, many different Control of Work processes were in place at the BP Lubricants plants. They were in varying

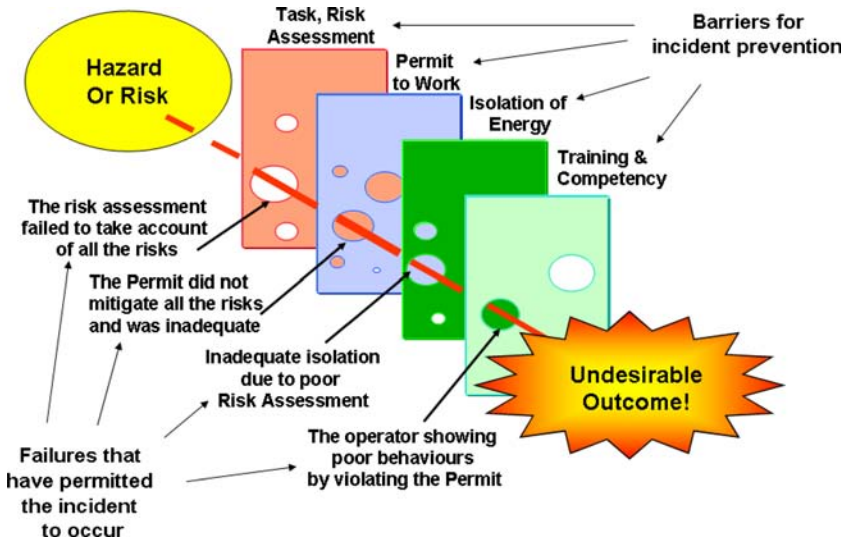

Figure 2. Barriers for incident prevention

formats, but were generally paper based, with very limited use of electronic document management. Permits developed at the plants showed significant variations in level of detail, and there was evidence of widely different implementation procedures and rigour.

While serious incidents in these plants that could be directly attributed to poor Control of Work were thankfully few, within BP as a whole there had been a number of fatalities over a 5 year period which analysis showed were the result of failures in Control of Work. In general, some 90% of fatal industrial accidents are found to have at least some association with inadequate Control of Work. Figure 3 illustrates the range of causes of the incidents analysed. It can be seen that not only the Permit to Work process, but also some of the less significant factors such as poor communication or training can still be attributed to Control of Work in its broadest sense.

BP STANDARDS AND COMPLIANCE

As a result of concern about these incidents and their causes, a BP Group Standard for Control of Work was developed, which will become mandatory at all BP sites at the end of 2009. This applies to all BP Staff and all Contractors working for BP on their premises, and stipulates that any Permit to Work system shall meet the following minimum requirements:

- There is a written procedure for the control of Permit to Work activities, as part of the local Control of Work arrangements.
- All persons with assigned Permit to Work responsibilities are competent to carry out those responsibilities.
- Training and competency of all those involved in the Permit to Work process is clearly defined and documented.
- Work planning, hazard identification and risk assessment and coordination are documented and clearly auditable.
- Work Permits are properly authorised, issued and controlled.
- An audit programme is in place to ensure that regular checks are made on Permits and the Permit to Work system to provide assurance that the required policies and standards are being applied and that lessons learned are communicated effectively.
- There are sufficient competent personnel at the premises to operate the Permit to Work system, carrying out all the required roles.
- There is clear definition of the resources required to train and assure the competence of personnel with designated Permit to Work responsibility.

CHALLENGES OF THE BP STANDARD FOR BP LUBRICANTS

Although the scale of risk in the BP Lubricants plants is generally significantly lower than in, say, a refinery or offshore platform, the workforce is still exposed to many of the same potential hazards, such as those resulting from working at height, in confined spaces, with hazardous materials or with stored energy.

The main challenge for the business was therefore to apply a consistent approach to Control of Work to improve safety performance at the plants and comply with the BP Standard, while reflecting the smaller size and complexity of the BP Lubricants operations. There was particular concern that the relatively low complexity of these plants could lead to a less stringent or consistent approach to risk and hazard management than would be applied in a more obviously dangerous environment.

A number of other concerns existed, including:

- Varying size, age and location of the plants
- Wide range of languages spoken by the workforce
- Wide differences in safety culture both in the plants and in the local community
- Wide variability in Control of Work procedures and practices
- Widely varying interpretation of Control of Work compliance requirements.

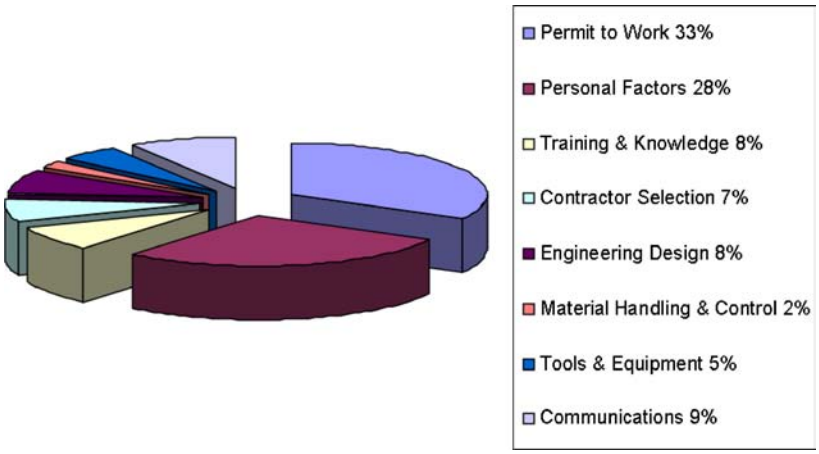

Figure 3. Causes of fatal incidents

An approach was needed to meet these challenges and deliver a consistent approach to Control of Work to enable the business to comply with the BP Standard.

EVALUATION AND SPECIFICATION OF SUITABLE APPLICATIONS

OPTIONS

It is not essential for good Control of Work, or for compliance with the BP Standard, to use an electronic tool to develop and manage Work Permits. However, given the challenges identified above it was decided that the development of a consistent paper-based process for all sites was an unrealistic approach. Some of the benefits of an electronic Work Permit system are:

- Better document control, as original work permits and associated risk assessments can be assigned unique, and permanent, identification references, and archived easily for future reference and auditing both on the issuing site and elsewhere.
- Ability to ensure a consistent process across all sites, since updates and changes to the Work Permit tool can be made centrally and transmitted simultaneously to all users.
- Integration of the Risk Assessment, Energy Isolation and Permit Issue processes into one activity.
- Automated notification of permit expiry.
- Better communication of work status both within the plant and externally.

In addition the following functionality was needed to meet the particular concerns of our business:

- Ability to assess the risk associated with all of the work carried out at the plants, not just the obviously dangerous activities
- Ease of translation into different languages
- Use of templates to avoid misinterpretation and for frequently repeated work
- Ability to transfer knowledge and best practice to, and between, sites
- Visibility across a site, the country and the business of recent and current permit activity.

Several options for electronic Control of Work applications were considered. Some of the Lubricants plants already used electronic maintenance management applications, which have limited facility for the development and issue of Work Permits. However their application is by no means universal within the business and since the preparation of Work Permits is not a primary part of their functionality the problem of inconsistency of Work Permitting is not resolved. As a result, several bespoke electronic Control of Work systems were reviewed.

There was a particular wish to identify suppliers who had real expertise in Control of Work, not just software design, since it was believed that this would lead to better support for the application both during its implementation and subsequent use in the plants.

Several such applications are commercially available. Two of these were already in use in parts of BP, including offshore exploration and production operations in the North Sea and elsewhere; refinery and petrochemical operations in the USA, UK and other countries; and the BP Lubricants Technology Centre in Pangbourne, near Reading, UK.

An important element in the selection process was the ability to tailor the application to the requirements of the BP Lubricants GSC manufacturing environment as described earlier. There was concern that a product that was sufficiently comprehensive, and potentially complex, to meet the requirements of a large refinery operation may not necessarily have been appropriate for a smaller, simpler facility such as a lubricant blend plant. Also, due to the diversity of the BP Lubricants manufacturing sites, the ability to issue Work Permits in many languages other than English was essential.

RAP was selected as being the most appropriate solution for BP Lubricants GSC plants, since although it was in successful operation in large single operations such as refineries, it also could be applied to the particular requirements of this business. This view was supported by experience of using RAP in the large BP complex in Grangemouth, Scotland, where not only is it used in the main plant, but also in several smaller remote operations. All these installations are connected, which confirmed the ability of RAP to work within our distributed business. There had also been good experience of using RAP at the BP Lubricants Technology Centre.

WHAT IS RAP?

History and Development

RAP was originally developed at BP Chemicals, Baglan Bay with the aim of capturing as much Control of Work and Risk Assessment experience as possible and making it easily available to all relevant staff. This experience, in the form of the controlling actions to keep the work safe, is accessible through an icon-driven method of job definition together with a number of prompting questions. The resultant Risk Assessment is then issued as a Permit to Work.

Since being installed at BP Baglan Bay in 1997, RAP has been considerably developed for operation in other environments. In 2000, RAP was used to replace the permit systems for the three business streams on BP's Grangemouth site (a total of 32 plant areas). Since its introduction there, many hundreds of thousands of Permits have been issued and the actions in the knowledge base have been re-used over 4 million times. RAP has also proved itself under difficult working conditions, having run through 20 turnarounds with some of these involving up to 550,000 man hours of work.

Since its installation in Grangemouth, RAP has been implemented at over 100 other locations within BP and elsewhere. RAP now incorporates industry Best Practice for Control of Work in each of its modules and its extensive risk assessment knowledge base covers most jobs in the

petrochemical industry including fuels, chemicals, lubricants and gas businesses. It can currently run interchangeably in any one of 18 languages. The resultant product is now extremely robust, very flexible and suitable for application at any site of any size.

Functional Elements
RAP has the following main functional elements:

- **A Risk Assessment knowledge base.** This is structured in terms of the Activities to be performed, the Tools to be used and the Conditions that will be worked under when carrying out maintenance work and operations. The key to the process is the initial definition of the planned work which leads to a structured analysis of the risks and their mitigating actions to ensure safe work.
- **An Isolation Module.** This ensures that work cannot be carried out unless the equipment is in an appropriate state of readiness. It also ensures that once the work has started, isolations cannot be removed until all work is complete.
- **A Permit Issue and Control Module.** This ensures that the planned task has been assessed by appropriately competent people. It also ensures that all involved are aware of the impact of the task being carried out.
- **A Competence Module.** This ensures that the right people will do the right thing on the system at the right point in the process.

Benefits
The major benefits of RAP are:

- Simplicity (there is only one Permit for any given work activity)
- Clarity (the definition and selection process minimises the risk of ambiguity)
- Conformity (compliance is a matter of routine)
- Usability (the Risk Assessment information is easily accessible when defining a task)
- Alignment (all Control of Work issues are present in one place)
- Visibility (allowing automated review and audit of the quality of the risk assessments)

RAP brings benefits to all levels of the plant. The workforce benefits in the form of increased awareness of risk and empowerment to decide how best to mitigate it, leading to a confident, competent approach to Control of Work. Plant and HSSE management benefit from being able to set standards for, and make changes to, Control of Work requirements consistently and quickly across the plants, and to review and audit Control of Work practice easily and comprehensively. The organisation as a whole benefits from a move to a more efficient and consistent risk assessment culture, resulting in a safer workplace.

APPROVAL FOR USE OF RAP

Initially, the selection of RAP for the Lubricants application was presented to BP Lubricants' HSSE and IT management for approval. It was proposed as a particularly appropriate tool for the GSC blend plants because of its language capabilities and ease of configuration to the widely varying size and scope of these facilities. Approval was granted to proceed to the next stage, namely to gain endorsement from operations management for its installation in all the manufacturing plants with the aim of having a standard Control of Work tool in the business.

RAP was initially presented to senior GSC management who readily accepted the need for a consistent approach to Control of Work to improve the safety of the plants and to meet obligations under the BP Standard. RAP was seen as an appropriate application for this purpose, and approval was granted to move to the next stage. An important aspect of this endorsement was the requirement that the cost of implementation was to be carried by individual plants, rather than from central budgets; the intention being that plant management should then feel a greater commitment to making this application work well at their sites.

It was then necessary to convince management and staff at the manufacturing sites of the benefits of adopting an electronic Control of Work system in general, and RAP in particular. Since a number of these sites already had an effective paper-based Work Permitting system in place in their own local language one of the main obstacles to overcome was the need to demonstrate that RAP offered significant benefits over their existing processes. These had in many cases been developed over several years, and in one region were common across a number of plants. The sites were therefore reluctant to give up their current processes and practices without a clear understanding of the benefits of moving to a common electronic system.

The acceptance process involved the presentation of RAP and the benefits of consistent Control of Work practice to regional plant managers' meetings, and also to supervisory staff at some sites. It was fortunate that a senior engineer at one of the plants had previously worked at the BP Grangemouth complex, and therefore had extensive experience of the use of RAP for Control of Work which could be brought to these presentations to add first-hand experience to the demonstration of the application.

Most regions and plants readily accepted the proposal, but the management in one region, which had recently adopted an element of an electronic maintenance management system to support Control of Work across a number of sites, was less easily persuaded of the benefits of moving to an alternative IT application. There was also concern about how well the requirements of specific local HSSE legislation would be met by RAP. One of the key elements in overcoming this reluctance was the realisation that it was endorsed by the BP Control of Work community as an effective tool to assist in achieving compliance with the BP Control of Work Standard, and could be adapted to include reference to such local legislation. Eventually all four regions had accepted the plan to roll out RAP to all sites, so the next phase of the process could begin.

Some resistance at plant operator and supervisor level had been anticipated, since generally these staff do not make

much use of computer terminals in their daily work and had been using paper work permitting procedures in their local language for many years. However, by giving "hands on" demonstration of RAP at a number of sites it was possible to overcome these reservations, and the response was entirely positive. The benefits of a structured approach to the process of risk assessment of tasks were readily appreciated, and several staff asked when they could start using the tool in their workplace.

DEVELOPMENT AND IMPLEMENTATION PROGRAMME

DEVELOPMENT

Functionality

Having gained acceptance of the proposal to install RAP in all our blend plants, it was necessary to develop a final version of RAP for application in the BP GSC plants. This had to take account of mandatory requirements for Control of Work within the BP Standard while retaining awareness of specific local practices and legislation and business ethos. For this purpose, several workshops were held, involving a small team of staff with specialist operational experience given authority to decide the final specification and performance. This team looked at each stage in the Task Risk Assessment process, challenging and adapting where necessary the icons, knowledge base controls, terminology and configuration. The resulting version of RAP embodied all the requirements of the BP Standard and the BP Lubricants Control of Work procedures

Languages

At least 12 different languages are spoken around the GSC plant network. As a result it was necessary to add these languages to the application, requiring typically 30,000 words to be translated. This was done using local translation services working closely with the plant staff to ensure that correct technical terminology was used. The translation work even included both UK and US English. Some modifications were required to accommodate pictorial languages (e.g. Mandarin, Korean, and Thai) but otherwise the process was straightforward. Each language set was "fine tuned" as required on site during the installation of the application, to ensure that specific technical terms were correctly translated.

Infrastructure

To enable the application to function across all plants in the business, reliable electronic communication was essential. It was initially planned to install the RAP database in each of the three regional data centres operated by BP (London, Houston and Singapore) to serve plants in these regions. However, after running a series of tests and examining the benefits of maintaining and supporting a single database it was decided that the RAP application could function from a single database installation in London.

PILOT INSTALLATION

The basic suitability of RAP for the BP Lubricants application had been established by its successful operation at the BP Lubricants Technical Centre for approximately 3 years. However, before embarking on the global RAP implementation programme, it was decided to run two pilot installations in blend plants; a large facility in the UK and a smaller operation in Austria. The aim of these pilots was to prove the application's function in sites of differing scale, with different languages and cultures, and to test the suitability of the chosen IT infrastructure. These pilots were run as full installations, and were seen in the plants as a permanent part of their Control of Work procedures, such that RAP continued in operation after the pilot process.

Following the successful completion of the pilots, several lessons were learnt. These included:

- That RAP was likely to be accepted with enthusiasm by plant staff at all levels, despite significant language and culture differences between sites, based on the very positive response to the pilots.
- That some minor development of the content and function of RAP would be needed to reflect particular local concerns and ways of working, but that the initial workshops had successfully addressed all the important requirements.
- That some minor changes to RAP were needed to increase the speed of the multi-language function.
- That the adoption of RAP would support the BP Lubricants business in complying with the BP Control of Work Standard.

GLOBAL IMPLEMENTATION

Organisation

It was decided to implement the installation of RAP on a regional basis, reflecting the organisational structure of the BP Lubricants business. In this way, installation could be made in groups of plants already familiar with working together, reducing travel costs.

To support this plan, a so-called RAP "Superuser" was nominated for each region whose responsibilities were to coordinate the installation and training programme in their region and act as a single point of contact between BP and the application vendor. These Superusers were drawn either from plants in their region, the regional HSSE Management team, or the regional Engineering team. Their specific job function was less important than their understanding of Control of Work and willingness to take on the role.

Regional IT management was also involved to ensure that the programme was properly supported in this area, although the demands on IT staff were minimal as the actual installation of RAP at the plants could be undertaken by the vendors themselves.

Within each plant, a similar RAP Superuser was nominated to act as the central contact point for the implementation and subsequent support of RAP at their

location. A RAP Administrator was also nominated to manage the installation, add or remove staff and contractor names as they changed, and undertake similar tasks. In smaller plants the Administrator and Superuser was sometimes the same person.

Preparation

Having set up the implementation and support structure, each Site Superuser was then asked to assist in the development of RAP for their location, including the liaison with local translation services to develop the local language version, and the definition of the number and identity of work "areas" within the plant.

Launch

Once each site in a region had been prepared for the installation, a "workshop" was run by the vendor in a single location in that region (generally one of the larger plants) which was attended by both the nominated Regional and Site RAP superusers, together with a representative of the local HSSE management team. These sessions were used to introduce RAP to the local staff and give outline training in its application, and also to reinforce the principles of good Control of Work.

These workshops were immediately followed by the installation of RAP in the sites in that region. Where possible this was carried out in one or two concentrated periods to ensure that the understanding of the application was still "fresh" with the site Superusers, and also to minimise travel costs and disruption to normal plant activities.

Site Installation

Installation at each plant generally ran over a 4 or 5 day period, led by the application vendor and involving the site Superuser, Administrator and all those staff involved in Control of Work at the facility. In some cases a Superuser from a site already using RAP also attended these workshops to add support based on their own experience. A member of the regional HSSE management team also usually attended to ensure consistent understanding of Control of Work practice at the site, supported in some cases by a member of the global Engineering or HSSE team.

These sessions began with a general introduction to RAP and a review of Control of Work practice, followed by the installation of RAP on the appropriate site computers and detailed training in its use. At the end of the week sites were issuing Work Permits with RAP, and their existing paper procedures were closed down. This was seen as an essential part of the process to ensure that the installation was functioning correctly; that all affected staff were competent in the issue of RAP permits; and that they moved immediately to its use to ensure that lessons learnt during the training were not lost.

The programme of installation and training ran over a period of approximately 18 months from mid 2005 to late 2006.

EXPERIENCE

FEEDBACK FROM USERS

Feedback from users of RAP at the plants has been almost universally positive, both during and since the installation programme. Even those sites where the use of a well established paper based process had led to some reservations about the benefit of an electronic system are now convinced of the benefits of RAP to their operation, in giving structure, consistency and rigour to their Control of Work process. Several site Superusers have given good feedback to the vendor which has led to development of the application to the benefit of us and other users.

The ability to issue permits in local language has been seen by sites as a particularly significant feature, given the diversity of our operations and also the presence in some areas of contractors and similar staff from a different country. This has ensured that staff and contractors fully understand the nature of the work they are about to undertake and the risks involved, with no ambiguity resulting from working in a foreign language with which they are unfamiliar.

AUDITING AND COMPLIANCE

One of the features of RAP is the ability to interrogate local applications from a central location. In this way it has been possible to review the number of Permits issued at sites, and their type, as well as more detailed information about RAP usage. While it is accepted that the number of Permits issued over a specific period is not an accurate indication of the quality or rigour of Control of Work at a site, as it will vary with the extent of work being undertaken, size of the plant and other factors, it has been a useful factor in discussions about Control of Work at some sites.

Formal Audits for compliance with the BP Control of Work standard have been carried out at a number of plants. Initially there was some concern that the Permits issued following the risk assessment did not adequately reflect and record that assessment. However, after detailed discussions with Auditors it was accepted that the process of risk assessment is sufficiently well structured and rigorous to meet the requirements of the standard and that the use of RAP is fully compliant with the appropriate elements of the BP standard.

MEETING OBJECTIVES

The implementation programme described here has helped the BP Lubricants business meet the objective of improving our Control of Work process in many ways, including:

- Better understanding of what the real risks are in the plants, and how to mitigate them.
- Better understanding of what makes good Control of Work at sites.

- The opportunity to develop and implement common training programmes for Control of Work (Risk Assessment) and Work Permitting around the sites.
- Improved cooperation between different areas at plants, leading to better work scheduling, resource planning, etc.
- Better contractor management, particularly at large sites where they are widely used.
- Better sharing and learning from experience in Control of Work.
- Identification and rectification of shortcomings in staff competence in the area of Control of Work, leading to safer general operations.

CONCLUSIONS

Having installed RAP in the BP Lubricants plants, there is now a robust and well accepted application in place for the management and implementation of good Control of Work. However, RAP is only a "tool" to guide staff through the risk assessment process, and to generate the Permit to Work. With this in mind, we have developed a training package for Risk Assessment and Control of Work which is being implemented across all our manufacturing sites. The Business is confident that the combination of a good Control of Work application, properly implemented by competent staff, has very significantly improved the safety of our plants.