Engineering Professional Performance

Training Manual

Training held at Thales

Tuesday 15 February 2010

Professor Ron Johnston
Executive Director, Australian Centre for Innovation

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Implementing PPIR

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TABLE OF CONTENTS

WORKSHOP PROGRAM

0830 Registration, Coffee

0900 Introduction – John Best – the significance of PPIR to Thales

0910 The PPIR Journey – Ron Johnston
- What is PPIR
- Why PPIR is important
- What today's Program is intended to deliver

0930 Discussion

0945 Scripted demonstration of 'what can go wrong'

1000 Discussion and feedback

1015 Presentation on the nine components of the PPIR Protocol
- Definition/explanation/illustration/FAQs

1100 Discussion and coffee

1130 Case Study Stage One (facilitated groupwork)

1230 Lunch

1315 Report back on Stage One and discussion

1345 Case Study Stages Two and Three (facilitated groupwork)

1430 Report back and discussion

1450 Self-evaluation on PPIR competency

1500 Close

YOUR FACILITATOR – Professor Ron Johnston

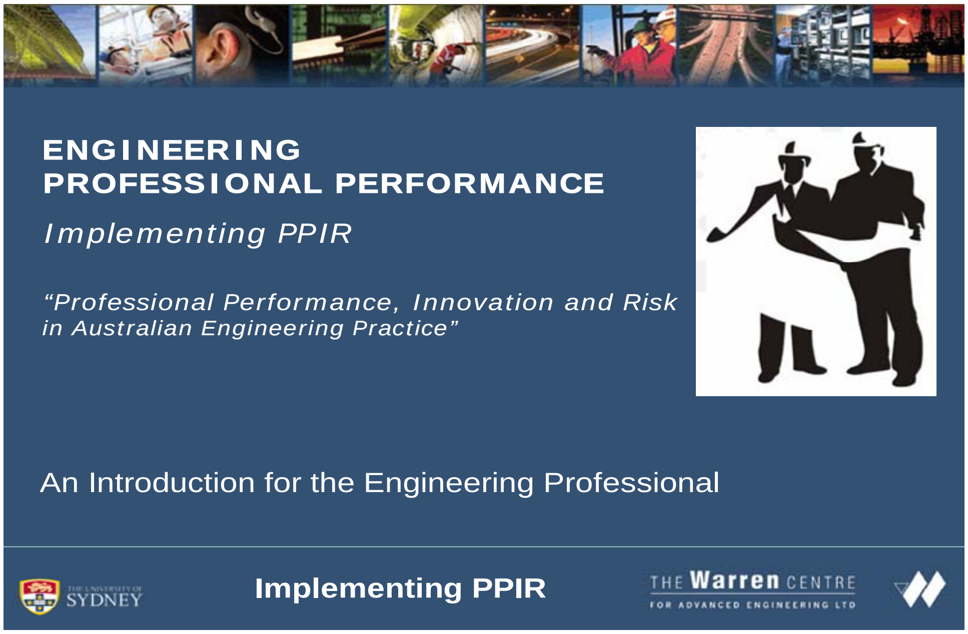
Professor Ron Johnston, Executive Director of the Australian Centre for Innovation has worked for more than thirty years in pioneering better understanding and application of the ways that science and technology contribute to economic and social development, the most appropriate structures and management approaches in research and higher education, and the processes and structures to facilitate innovation.

He is one of Australia's leading analysts of the changes that are transforming the worlds of business, education and leisure. He combines a deep understanding of the leading edge of science and technology with refreshing insights into the ways they can impact on government policy, management, consumers and the community.

In recent years, as a result of much experience in change management, he has devoted considerable effort to communication and facilitation. His special skill is based on the breadth of his knowledge across technologies, and his ability to integrate them into a socio-economic and environmental context. He is a dynamic and passionate presenter and listener, painting the 'big picture' of change and engaging his audiences in thinking through what it might mean for them.

Ron Johnston was a member of the Warren Centre's Management team which developed the PPIR Protocol.

INTRODUCTION TO PPIR



PPIR: An Introduction for Engineering Professionals

Where?

What?

How?

Why?

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What does the PPIR Protocol do?

- It informs and guides Professional Engineers on essentials of **performance** in any engineering task
- Informs and guides all parties/stakeholders:
  - o Role and obligations of engineering professional
  - o Effective use of engineering professional
- Defines essentials of task-specific **performance** against which 'duty and standard of care' can be assessed objectively in prospect and in retrospect.

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Why is PPIR Needed?

… to respond to the Contemporary Realities for Engineering Professionals

- **Commercial relationships** - too complex and ‘legalistic’
- **Procurement** – tick the box variety
- **Risk management** – has become risk segmentation and allocation
- **Insurance** - risks harder to understand and assess
- **Litigation** - time-consuming, costly, unpredictable

➔ less opportunity and enthusiasm for engineering innovation.

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Why is PPIR Protocol Needed?

- The engineering profession already has well defined specifications for the its requirements with regard to **Competency** and **Ethics**
- The missing “third leg of the stool” is the expected **Performance** of professional engineers.

In simple terms, “Performance” is how the professional engineer approaches and arranges a new task and how it is undertaken to ensure delivery of the final agreed outcome

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What Will the PPIR Strategy Deliver?

For Buyers and Sellers of Engineering services

- A better way of reaching a clear and shared understanding of what an engineering task is about and what all parties expect from it.
- A more cost-effective outcome with better management of risk, including that involved in use of innovative engineering solutions

For Professional Engineers and their Employers

- A better understanding of the expectations of others and clarity on the responsibilities of the engineer and others involved in the process
- A fully integrated professional performance environment - in both the engineering and commercial aspects.

Why might a Professional Engineer want to use PPIR?

'It helps me understand and respond to the expectations of others and to clarify my responsibilities and the responsibilities of others'

'It gives me a better chance of applying effectively my hard-won professional knowledge and skills to ensure the best outcomes are agreed and achieved'

'It helps my team members understand better what our engineering team should be trying to achieve and to support my team leadership'

'It sets up a much better basis on which to argue for an integrated approach to all the risk issues and for proper management of these risks'

'It gives me a basis that is widely-accepted from which to apply my best professional judgement to the issues and the circumstances'

'I have confidence that if my professional judgement is later questioned in a dispute or litigation, my judgment will be assessed using the same approach I used at the time'.

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Objectives of The Workshop

1. To introduce you to the PPIR Protocol objectives

2. To develop an understanding of the importance of PPIR

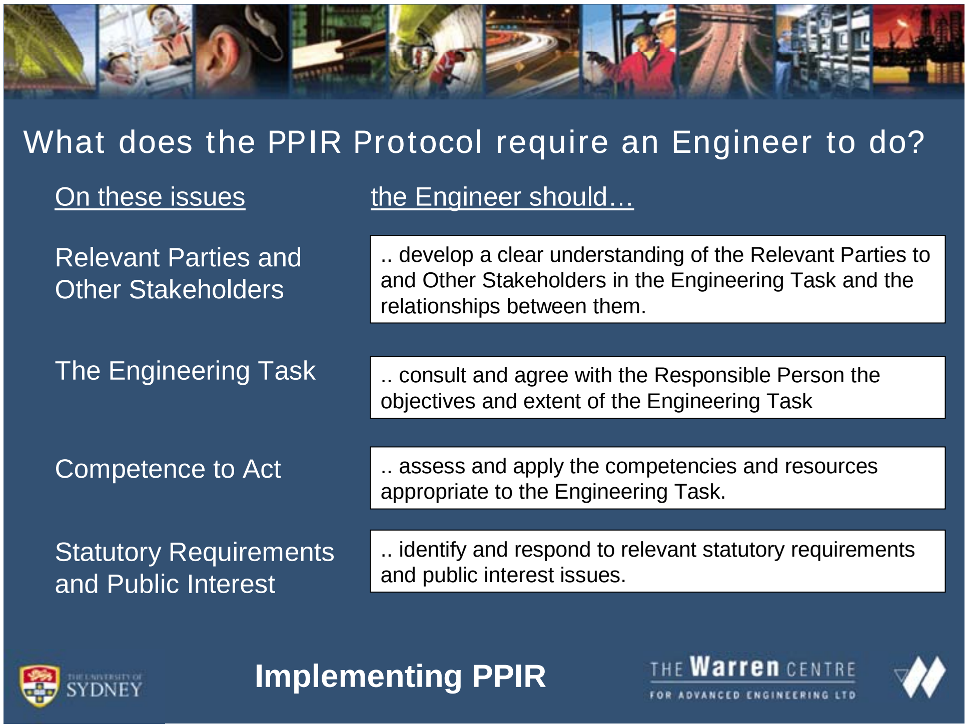
3. To outline the nine components of the PPIR Protocol

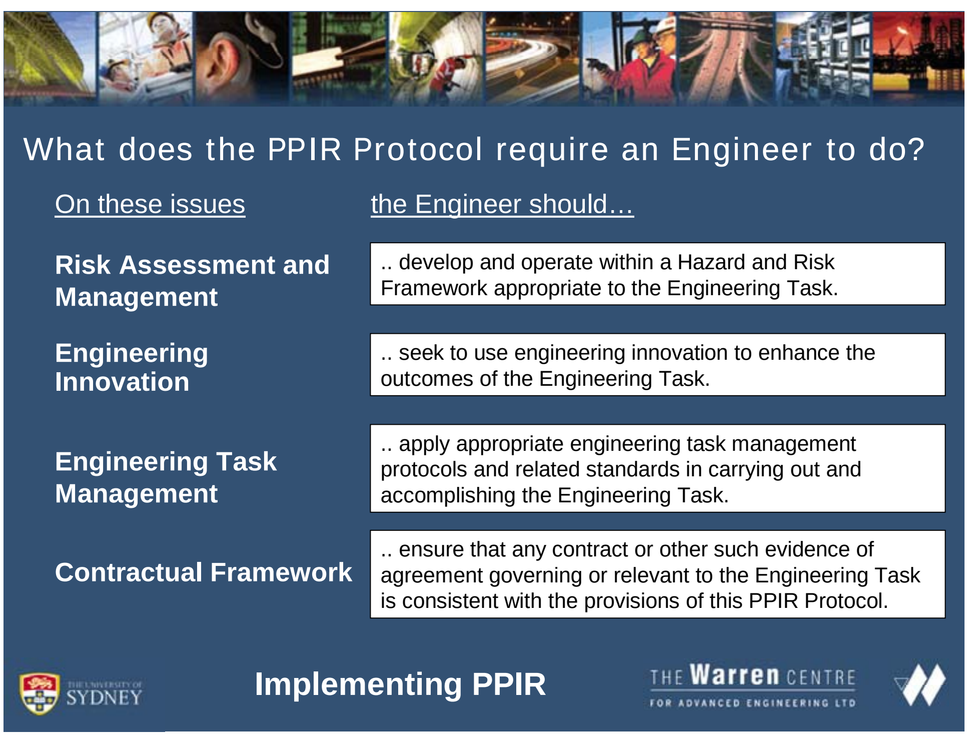
4. To examine the application of the Protocol through a case study

5. To evaluate your competency with the PPIR Protocol

6. To reflect on the best procedures to introduce the PPIR Protocol into thales practices

COMPONENTS OF THE PPIR PROTOCOL





1. Preamble

This PPIR Protocol documents the essentials of performance for Professional Engineers acting in a professional capacity.

The objectives of the PPIR Protocol are to:

- inform and guide the Professional Engineer acting individually or as a team member on the essentials of performance in considering and undertaking an Engineering Task;
- inform and guide all Relevant Parties and Other Stakeholders on the role and obligations of Professional Engineers and the effective use of their services; and
- define the essentials of performance against which the duty and standard of care of Professional Engineers can be assessed objectively in prospect and in retrospect.

2. Relevant Parties and Other Stakeholders

The Professional Engineer should develop a clear understanding of the Relevant Parties to and Other Stakeholders in the Engineering Task and the relationships bw them.

Accordingly, a Professional Engineer should:

identify the Responsible Person to whom the Professional Engineer is responsible in performing the Engineering Task and the entity that person is representing

identify the person(s) and entities for whom the Professional Engineer is responsible when performing the Engineering Task

agree with the Responsible Person the approach to address all issues involving the interests and expectations of Relevant Parties or Other Stakeholders relevant to the Engineering Task

take reasonable steps to:
identify other Relevant Parties and Other Stakeholders; and
(ii) map the relationships between them for the purposes of the Engineering Task, considering both the individual persons and the entities involved; and
(iii) assess their individual interests and expectations and the likely impact of these interests and expectations on the Engineering Task

re-assess these issues throughout the Engineering Task and respond accordingly

3. The Engineering Task

The Professional Engineer should consult and agree with the Responsible Person the objectives and extent of the Engineering Task.

Accordingly, a Professional Engineer should:

- assess the objectives, scope, extent and context of the Engineering Task, exploring particularly the relevant expectations and outcomes and the perceived best interests of the Responsible Person
- consider and discuss with the Responsible Person alternative methods of achieving the objectives, scope and extent of the Engineering Task
- define and document the Engineering Task agreed with the Responsible Person and the exclusions therefrom
- if the Engineering Task so defined cannot be agreed with the Responsible Person, consider whether it is appropriate to undertake it
- ensure that any documentation of the Engineering Task is consistent with the definition agreed with the Responsible Person
- regularly re-examine whether the objectives, scope, extent and context of the Engineering Task have changed, and consider and respond as above to any such change

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4. Competence to Act

The Professional Engineer should assess and apply the competencies and resources appropriate to the Engineering Task.

Accordingly, a Professional Engineer should:

- assess and respond to the range and availability of professional knowledge, competencies and resources required to undertake the Engineering Task and assess any material uncertainties in these respects
- reach agreement with the Responsible Person as to how these uncertainties should be handled or failing such agreement consider whether it is appropriate to act
- not otherwise profess a capacity to undertake the Engineering Task if any part of the required professional knowledge, competencies and resources are lacking or not available at all the relevant times
- regularly re-examine these issues throughout the Engineering Task and keep the relevant persons promptly informed.

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5. Statutory Requirements and Public Interest

The Professional Engineer should identify and respond to relevant statutory requirements and public interest issues.

Accordingly, a Professional Engineer should discuss and agree with the Responsible Person the appropriate response to:

- laws, legislations, regulations and ordinances that may be relevant to the Engineering Task
- latent liability issues that may be relevant to the Engineering Task
- safety, environmental, public health and other public interest issues that may be relevant to the Engineering Task;
- ways in which these issues may impact upon or change the definition of the Engineering Task or the proposed approach to management of the Engineering Task

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6. Risk Assessment and Management

The Professional Engineer should develop and operate within a Hazard and Risk Framework appropriate to the Engineering Task.

Accordingly, a Professional Engineer should:

- identify and assess the hazards and risks directly related to or associated with the Engineering Task, and the relationships between them, in the form of a Hazard and Risk Framework
- delegate risk management and accountability to the parties best able to manage that risk provided there is documented evidence of the parties' capacity and willingness to accept such delegation
- document and apply an appropriate plan to manage the identified hazards and risks in the Engineering Task
- where there is not the capacity or willingness to manage or bear the risk consider whether it is appropriate to delegate or accept delegation of risk management
- document and apply an appropriate plan to manage any unidentified hazards and risks in the Engineering Task;
- keep relevant persons informed on all material risk management issues throughout Engineering Task
- regularly re-examine and audit (using independent audit if appropriate) risk management performance relevant to the Engineering Task and respond accordingly

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7. Engineering Innovation

The Professional Engineer should seek to use engineering innovation to enhance the outcomes of the Engineering Task.

Accordingly, a Professional Engineer should:

- assess whether Engineering Innovation is fundamental or beneficial to the Engineering Task, and evaluate the potential benefits
- evaluate whether the risk profile and impact of Engineering Innovation requires change within the Hazard and Risk Framework for the Engineering Task
- assess the skills, knowledge and resources issues introduced by Engineering Innovation;
- assess the appropriate action required in regard to intellectual property issues introduced by Engineering Innovation;
- agree and review regularly with the Responsible Person throughout the Engineering Task the approach being taken to use Engineering Innovation effectively

8. Engineering Task Management

The Professional Engineer should apply appropriate engineering task management protocols and related standards in carrying out and accomplishing the Engineering Task.

Accordingly, a Professional Engineer should:

- adopt and apply a project management system, quality assurance system and change management process appropriate to the Engineering Task
- assess and maintain the transparency and integrity of all transactions involved in performing the Engineering Task in the context of prevailing community and professional standards
- arrange an effective procurement program governing the supply of materials and services by third parties
- log daily material events and decisions throughout the Engineering Task
- arrange a systematic approach to timely disclosure to relevant persons and resolution of technical and commercial issues arising in the course of the Engineering Task
- develop and maintain an effective system of timely communication between all those directly involved in performing the Engineering Task
- identify and respond to potential conflicts of interest
- upon completion of the Engineering Task assess and document the performance and outcomes achieved in delivering the Engineering Task.

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9. Contractual Framework

The Professional Engineer should ensure that any contract or other such evidence of agreement governing or relevant to the Engineering Task is consistent with the provisions of this PPIR Protocol.

Accordingly, a Professional Engineer should:

- review the provisions of any contract or other such documentation to ensure they are based on the agreements reached with the Responsible Person in applying this PPIR Protocol and do not override or diminish the intent of such agreements
- request and seek to gain access to third party arrangements or contracts relevant to the Engineering Task and identify and seek to resolve any issues in conflict with this PPIR Protocol
- negotiate with the Responsible person where the contract or other such documentation contains terms that are contrary to this PPIR Protocol
- consider whether it is appropriate to act if agreement cannot be reached on any of the above

CASE STUDY OF THE APPLICATION OF THE PPIR PROTOCOL

Objectives

This is a 'real life' case study of an engineering project. By working your way carefully through it you should develop a clear understanding of the many ways in which the PPIR Protocol can guide the professional engineer's decisions and actions to ensure a high level of performance of the engineering task.

Case Study One

Background

The site

Woongoolba continues to be a thriving sugar-growing area, with 6500 hectares of land under sugar cane and growers looking to expand into adjoining Shires. The mill is the largest grower, producing 55,000 tonnes per annum. The Sugar Mill is the only mill in Australia to produce organic certified sugar and has its own distillery (alcohol factory) on site to convert molasses into alcohol, in particular fuel alcohol. This provides another use for molasses, which was once only used as a stockfeed for cattle.

Technology

Cogeneration occurs primarily during sugar mill crush where a major part of boiler output is supplied as steam to the sugar mill for heat to evaporate water from sugar juice. The plant was designed to be part of a regional, tertiary-treated, effluent reuse scheme. All water used in the plant (some 3–4 ML/day) is sourced from a water reclamation facility (sewage treatment plant).

The Contractor

The Contractor has ample experience in the design and construction of cogeneration plants, but only limited experience with the use of greenwaste as a fuel.

Energy purchase and supply

The generator is registered as unscheduled and is an accredited generator under the Green Power scheme. The plant is expected to produce 140 GWh of electricity per annum and is connected to the major utility's local electricity network. Power generated from the project is sold under a long-term agreement. The generator operates 24 hours a day for approximately 300 days a year.

Fuel source

Fuel for the plant is supplied from the sugar mill and from contracts with various councils. Biomass consists of bagasse from the adjoining sugar mill in the mill crush with the non-crush fuel being predominately greenwaste from councils and woodwaste from nearby wood mulching industries. Green waste from across south-east Queensland is collected and sorted at the newly established green waste handling facilities. Major transportation firms also benefit from contracts to transport the biomass to the site. The problem of a glut of biomass at Council refuse dumps and landfills throughout the region will be solved for many years by the commissioning of the Project.

Environmental impact

The project is expected to save 130,000 tonnes per annum of greenhouse gas emissions.

The new plant has replaced previously high emission boilers with more efficient high pressure boilers resulting in improved particulate emissions (<250 mg/Nm3 down from over 800). In addition, the plant reuses tertiary treated water from the local council.

Phase 1 - Setup

The Contract - for the design, manufacture, delivery, construction, commissioning and testing of a turnkey 30MW cogeneration power plant supplying power at 11kV to the switchyard and using renewable green-waste fuels – bagasse during the cane crushing season and green and timber waster (some 200,000 tonnes) for the rest of the year. The plant is to generate electricity for injection into the utility network as well as steam and electricity to power the mill and an associated distillery.

The Client - a Power Utility with a portfolio of coal-fired thermal, wind, and hydroelectric facilities, but with no significant experience in cogeneration or the associated waste fuels preparation. The Sugar Mill owner had a separate contract with the Client.

The Client appoints a project manager, plus a superintendent responsible for design and construction hired from a consulting company.

Inclusions - full cogeneration power plant including its boiler, turbine/generator, feedwater system, instrumentation and control and electrical systems. Construction of an operational drainage pond, an incoming "fresh" water supply pond and respective pumping stations, A 17,000M2 waste materials processing hardstand area, fuel oil station, switchyard foundations, access roadways, water treatment plant, waste fuel receiving station and delivery conveyors to the boiler, interception of existing Mill bagasse conveyors to redirect fuel to the new boiler, flue gas cleaning system, ash collection system and all associated plant.

Exclusions - waste fuel processing plant and incoming green-waste fuel supply contracts, supply of water from local Municipal sewerage treatment plant, supply and installation of the switchyard equipment.

Location - in an existing small sugar mill in a congested site bounded by a public roadway, existing mill buildings and a bagasse loft on its northern, eastern and western boundaries.. Existing bagasse conveyors criss-cross the site but only one is to be removed by the Client prior to the sitework commencement date. Access is therefore quite limited especially for the big lift items (130 tonnes) which will cause the foundations work to be done in stages. There is no available knowledge of the ground structure or of buried machinery and pipework on the proposed site. The site has acid sulphate soils and the EPA requirements are for zero release of any runoff from construction works or rain.

Timing – commencement 10 February to Practical Completion by 11 November one year later ie 21 months duration. Liquidated damages would apply for late completion or failure to meet tests performance on efficiency, reliability, maximum power capacity, on both biomass main fuels - bagasse and green waste/wood materials. Light oil was used for light-off start-up.

The Sugar Mill is fully operational only to suit the sugar cane crop readiness for harvest and the size of the crop. Generally this is from June to November although at times when crop is available it can continue to December. Mill readiness runs generally start in June with imported bagasse fuel dumped in large open piles adjacent to the bagasse loft and inserted into the loft by front-end loader. Via this loft building and its old conveyors the fuel was circulated internally in the mill and directed to their very old boilers.

PPIR Protocol Audit

As the professional engineer with responsibility for this project, you should now work through the nine components of the PPIR Protocol to assess whether actions need to be taken. Thus:

- Have all the **relevant parties and other stakeholders** (Component Two) been identified? Who are they? (make a list). Is there a need for negotiations with any of the relevant parties to clarify their expectations and responsibilities?

- Have the **objectives, scope, extent and context of the engineering task** (Component Three) been adequately assessed and discussed with the Responsible Person?

- Have you assessed whether you have the necessary **competencies and resources** (Component Four) to successfully address the task?

- Have you identified and addressed relevant **Statutory Requirements** (what might they be?) and **public interest issues**? (Component Five)

- Have you identified the **hazards and risks** (Component Six) associated with the engineering task? What are they?

- Have you assessed whether there are opportunities to apply **engineering innovation** (Component Seven) to this task? What might they be? Do they raise any issues of intellectual property or risk?

- Have you designed and propose to apply appropriate **engineering task management** (Component Eight) procedures?

- Are the contractual terms in accord with the **PPIR Protocol**? (Component Nine)

Phase 2 – Problems identified in the first 12 months

The Client ordered their green waste fuel processing equipment from Sweden (a Svedala hammer, rather than a chipper as recommended by contractor) about six months after the contract start date and with no involvement with the contractor. A "final" fuel specification statement was given to the Contractor by the Client three months after the Contract signing date. During the pre-Contract discussions the green-waste fuel preparation equipment had been removed from the Contractor's scope of work.

The Sugar Mill was upgrading cane-processing equipment in the same period and internal road access has to be shared in some areas. Sugar trucks have also to access the same roadways during the processing seasons as does the construction equipment movements.

Construction difficulties - many objects were found underground during piling. Piling depths were greater than planned. Ground was very soft and had a high water table.

Foundations work was impeded by imported Bagasse fuel, from the loft and front-end loader work, being wind blown into prepared foundation and by obstructing the access for foundations work. It also lead to industrial problems with the employees and the use of goggles/safety glasses became even more essential.

The remaining Mill bagasse conveyor running diagonally across the boiler site is very poorly maintained and regularly spills fuel into the construction area.

The mill owner decided just before Contract date to relocate his existing spray pond eastwards and did not properly fill or consolidate the old pond site which was to be incorporated into the waste fuel preparation hardstand area, leading to collapse when it was being constructed. The area all had to be excavated and consolidated properly.

Environmental difficulties - While the contractor take great care to avoid acid sulphate soil to escape from the site onto the roadway gutters, the Mill carries on its usual practice of ignoring the EPA and discharges dirty and hot water into the drains and causes a fish kill in the local river. The EPA thereafter gives the site a very high focus.

PPIR Protocol Audit

Seven substantial problems were identified in the first 12 months of construction.

- Could a more thorough application of the PPIR Protocol have avoided or mitigated any of these difficulties?

- How can the various components of the PPIR Protocol be applied to attempt to remedy the problems?

Phase 3 Issues arising in moving to commissioning and testing

The Sugar Mill's need for secure milling operations in June-November made the Mill choose with Client approval to not provide any bagasse fuel to the new plant for commissioning. Commissioning therefore is limited only to green waste fuel prepared by the Client.

Problems with the green waste - first voiced concerns on the quality of the initially prepared waste fuel from the Svedala machine were well-founded. On the first run of the waste fuel conveyor equipment on 1st October, the storage bins at the boiler front were filled ready for test firing. On the following day when the feed ribbon screws under the bins were activated to send fuel to the boiler feed chutes, the ribbon screws jammed fuel up against the storage bin discharge ports and compressed, collapsing the screws and causing such friction, metal to metal, that a fire started and damaged the equipment.

The real problem was that woodchips were expected as the fuel and the machine purchased by the Client was a hammer grinder which hammered the wood into long fibres which after a very short time in the storage/stockpile knitted together and behaved like a mass rather than as individual fibres. This was especially so with palm trees which balled up like cotton waste after going through the hammers. It took great force to rip the bunches apart and in large quantity proved to be beyond the capability of the installed machinery.

Responses - it was decided that no storage should be allowed in the fuel bins because of the nature of the prepared fuel and the ribbon screws operating to immediately evacuate any transported fuel which arrived in the storage bins, the fuel was able to be moved out of the bunker and into the boiler with few jam-ups and screw collapses. Tougher screws were also installed but even this did not prevent the occasional jam and screw collapse. Drive sizes were also increased on the screws but this did not resolve the main issues. At the waste fuel receiving end the chain conveyors receiving fuel from the Client's prepared stockpile also has serious problems with jamming and overloading their drives. These drives were also upgraded to the limits of the installed cabling and also had gearbox changes, but were still prone to tripping on overload when the fuel bunched up into very large piles.

Commissioning and testing - the plant was fully staffed with contractor personnel at all pinch points and slowly ramped up the load to maximum for a short demonstration of full load on 24th December. Further damage caused by oversize fuel pieces aborted the effort but were quickly fixed. On 29th December load was raised to a maximum of 30MW for five minutes before one of the Client's frequent superlogs totally jammed the system. We immediately claimed Project Completion, having acquired sufficient extensions of time through to that day and in our opinion having demonstrated the plant as best we could under the bad fuel circumstances.

It took many months thereafter to get the Client to face up to their responsibilities for the waste fuel preparation and supply and the usual contractual and financial consequences. Eventually PC was agreed and given by the Superintendent and the Contract record shows completion on time.

Problems with the water supply - problems arose with the quality of the incoming water supply from the local sewerage treatment plant. It was higher in salts than specified. The demineralisation plant installed was in continual short-run and regeneration mode and the run time was down to around 6 hours at times. This caused a great shortage of demineralised water to supply the boiler and the Client had to truck alternate supplies by tanker from a nearby power station. Even after the demineralisation plant was optimised for this water the run times were still unacceptably short and the Client was becoming concerned about the significantly increased chemical usage in his new demineralisation plant. The cooling tower also had to be more regularly blown down to restrict the salt build-up in the tower and steam turbine condenser circulating water.

The salinity of the incoming fresh water added to salt also coming in within the waste fuels (probably from rootball soils), causing serious problems in the boiler ash system. The boiler flue wet scrubbers were operating at very high spray water salinity levels as discharging high salinity water to waste drains was npt permitted for environmental reasons and the ID fan and downstream ductwork was also suffering heavy corrosion. To assist the Client a design exercise was held to review the ash plant to see where the weak equipment links would be in operating at very high (around seawater) salinity levels. It was in the interest of the contractor to see this plant succeed but this was actually a move by the Client to discharge more salt up the wet chimney as they were incurring costs from having to regularly truck salt rich ash system water back to the sewerage treatment plant.

PPIR Protocol Audit

- Could any of the difficulties in commissioning, testing or completion have been avoided or mitigated by a more detailed application of the PPIR Protocol? For example, could a more rigorous exploration of the Clients' expectations with regard to green waste supply (Component 1) and/or the nature of the engineering task (Component Two), recognising that the Client had limited relevant experience with these matters, overcome some of the major problems? In what way?

- What actions might have been taken under Component One (clear understanding of the relevant parties) to clarify the responsibilities and requirements of the client, the contractor and the sugar mill owner?

- Could the application of the PPIR Protocol have assisted in identifying and managing the issues that arose concerning water supply? In what way?

SELF-ASSESSMENT OF PPIR PROTOCOL COMPETENCY

Q1. What do each of the nine components of the PPIR Protocol address?

Q2. Define the Responsible Person, Relevant Party, Engineering Task, Professional Engineer

Q3. What are some major challenges for the Professional Engineer?

Q4. What benefits could the adoption of the PPIR Protocol deliver?

Q5. Scope the way in which you could apply the PPIR Protocol to an engineering task

Q6. What are the objectives of the PPIR Protocol?

Q7. In an engineering task for which you are responsible, identify the Responsible person, People for whom you are responsible, and Related Parties

Q8. Outline the processes you would use to scope an engineering task

Q9. How would you assess your competence to act, and that of your organisation?

Q10. What process would you use to identify statutory requirements and public interest?

Q11. What is involved in developing and applying an appropriate hazard and risk framework?

Q12. How should the professional engineer seek to use engineering innovation to enhance the outcomes of the engineering task?

Q13. How does the professional engineer determine what are the appropriate engineering task management protocols and standards to a particular engineering task?

Q14. What are the processes involved in ensuring that the conditions of a contract are consistent with the PPIR Protocol?

PARTICIPANTS

Thales

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