Inspection system development project for critical power generation assets

Low Pressure Turbine Disc Assembly
WE CANNOT SOLVE OUR PROBLEMS WITH THE SAME THINKING WE USED WHEN WE CREATED THEM

-Albert Einstein
Innovation distinguishes between a leader and a follower.

Steve Jobs
Eskom Rotek Industries SOC Ltd is a wholly owned subsidiary of Eskom Holdings and strives to live up to its vision to be a world-class energy industry services company. Previously known as Rotek, Roshcon and Rotran, these 3 single entities merged in 2015 to shift performance and grow sustainability into the future.
Eskom Rotek Industries Strategy & Values

Strategy:
Shift performance and grow sustainably

Our Mandate
To provide strategic and commercial lifecycle services to Eskom’s line divisions, cost effectively

Our Mission
To be a sustainable business, within the Eskom Enterprises group of companies, providing high quality mission critical services to Eskom’s lines of business and evolving Africa Strategy

Our Vision
Eskom Rotek Industries will be a world class energy industry services company

01 Zero Harm
02 Excellence
03 Integrity
04 Innovation
05 Customer satisfaction
06 Sinobuntu
Presentation summary

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Project summary

- **Client**: Komati Power Station
- **Lead time**: 18 months
- **Location**: Eskom Rotek Industries
  Turbo Gen Services Product Group – Rosherville, JHB
- **Cost**: R15 million
- **Successful?**
  - **Budget**: Yes (With VOs)
  - **Delivery date**: No
  - **Performance**: Yes
Steam turbine
Background

• Inspection has widespread uses in industry ranging from ensuring freedom from manufacturing flaws and quality checking during fabrication through to In-service Inspection and management of structural integrity during plant operation.

• In complex applications, ISI may be used in an iterative way to detect and monitor degradation as part of a larger engineering program to management the structural integrity. Inspection solutions provided in codes are often absent or are ineffective.

• During that last decade of the 20th century, international interest focused on ISI efficacy for the more complex applications to the extent that critical inspections now had to be qualified with respect to performance and effectiveness.

• Inspection procedure qualification therefore was instituted and defined as the systematic assessment of the performance of and NDT System to detect, size and disposition prescribed flaws in prescribed components.
Strategic nature of the project

- Tracked at the executive level (Outage Project Management and Outage Review Committee)
- Eskom PMO & Rotek Industries PMO involvement?
- PM Maturity levels in Eskom.
- Cost saving drive (Financial situation)
- Self sufficiency
- One of many initiatives in Fossil, Gas and Nuclear
- Home grown technology
- Quicker inspection response times (Commercial process)
- Shorter down times
- Electricity availability
- Happy consumers
Project scope and quality

- During normal operation, the LP turbine discs (Komati design) are affected by hoop stresses that result in stress corrosion cracking in the areas above and below the drive pin holes, and the disc bores.
- As a result these areas have to be scanned with a high level of accuracy, during schedule intervals without having to disassemble the LPs, reducing outage time and saving on refurbishment costs.
- Reference specimen with exact specifications as the real discs were used to ensure accuracy.
- OEM drawing (where available) and 3D scans used as prime inputs to the design process.
- Develop and qualify an Ultrasonic Testing inspection (Specialised NDT) procedure of the LP turbine shrunk-on discs, including hardware and software.
Project scope and quality (contd.)

- QA Program for the development, design and manufacturing, testing, commissioning and qualification of NDT Technicians.
- Define and select methods of inspection
- Technical justification report
- Define general spec for UT equipment and mechanical components
- Design and manufacture the mechanical equipment
- Spec and manufacture test samples to carry out tests and commissioning and qualification.
- Programme of qualification – methods and tools.
- Programme for qualification & certification for NDT operators
- The qualification report
The project organisation

- Project Sponsor: Komati Power Station
- Project Manager
- Design Engineer
- Draughtsman
- NDT Services Dev Team Leader
  - NDT Level 3 Specialist
- IQA/B
  - Client NDT L3
- NDT Technician: UT Level 2+
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Cost & commercial/procurement

• The cost of the project was composed of local (development, testing and operation) and foreign (hardware & software) components
• Not capitalised
• Fully funded by the client
• Estimates done and approved by the client, then a task order issued to us to trigger project start
• Sole source justification for foreign supplier without prior tendering (firm fixed price contract)
• Milestone invoicing done to us and similarly by us to client
• Commercial closure after project successful handover to Komati Power Station.
• National treasury facilitated the payment of forex
Stakeholder management

- Project managers are often faced with challenges, especially in managing stakeholders (internal & external).
- Followed best practice when handling these situations during this project:
  - We were clear and transparent from the start of the engagement
  - Avoided surprises and always had a contingency plan.
- The stakeholders’ expectations were taken into account and they helped us to manage the issues.
- Issues were documented in an issue log, a tool used to document, monitor, and track issues that need resolution.
- Unresolved issues can be a major source of conflict and result in stakeholder expectations not being met.
- A power/interest grid can be used to group stakeholders based on their level of authority (power) and their level of concern (interest) for project outcomes.
Risk management

• During the project planning stage, risks were identified, documented and quantified using formal and informal means (technical, financial, socio-political, legal, schedule).
• Appropriate responses in terms of controls were adopted and put into effect until the risks severity became at par with the project risk appetite.
• For example: Forward cover was taken to cushion exchange rate fluctuations for the foreign component (Risk transfer).
• Black swans (Low likelihood but very high severity) were also flagged for monitoring.
• Schedule slip became an issue due to a lot of unknowns typical of development projects.
• One major risk worthy of mention is the shortage of the expertise in the whole world to properly carryout a full qualification process. International resources/experts were utilised.
PLCM phases

1. Initiation
   - Commercial / Orders
   - Project Charter / IQA
2. Planning
   - Tech Justification / Insp. Obj. / Qual. conduct doc
3. Execution
   - Insp. Design, Trials and Qual. doc compilation
4. Close-out
   - Hand-over
   - Commercial operation
Integration

Hardware (France)

Software (Zetec Canada)

Integration RSA & France

Personnel (RSA)

Qualified inspection procedures
Close out

- Final acceptance of solution by Komati Power station engineers triggered the close-out of the project.
- PQP final audit and sign off by all parties.
- The total project package documentation was then handed over to the client.
- Final invoicing (commercial closure).
- Technical closure and preservation of IP.
- Qualification certificates.
- Procedure is however commercially applied.
- Equipment owned by Eskom Rotek Industries but offers inspection services exclusively to Komati Power Station and no additional premiums.
International trends

• European Network for Inspection and Qualification (ENIQ)
• In practice, qualification can be performed with varying degrees of complexity and cost, varying from a capability statement (a simple form of technical justification) based on existing evidence, through to an extensive qualification consisting of a detailed TJ together with open and blind trials on full-scale test pieces. Some countries and organisations might wish to formalise this by providing for a number of different qualification levels and qualification approaches depending on such factors as the safety significance of the component, the role of the inspection in ensuring its structural integrity, and the difficulty or novelty of applying the proposed NDT technique.
• The level of rigor prescribed for this project is usually confined to Nuclear utilities.
Conclusions & lessons learnt

- The rigor adopted for this type of inspection system qualification was more of an overkill, fit for nuclear plant. At best, the performance demonstration option should have been selected.
- Lack of expertise in this space tends to drive the costs high as foreign exchange is required for the overseas portion. Consider localisation, perhaps? Knowledge transfer clauses?
- Project was first of its kind in RSA and Eskom, the scope changes impacted on the planned delivery date severely.
- The same resources that worked on the development also had other projects and clients to attend to, production also took precedence whenever these clashed.
- The development of detailed procedures for the acquisition and analysis of ultrasonic data enables ease of transfer of skill.
- The IQA needs to be totally independent of both the developer and client. Not the case.
Questions / Comments

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Thank you