Improving of the Steam Plant
Groote Schuur Hospital
Western Cape, South Africa

GGHH Agenda Goals

- **Energy**

Hospital Goal

- **Reduce energy costs**
- **Reduce carbon dioxide emissions**
- **Improve Infrastructure**
- **Reduce Wastage**

Progress Achieved

- Financial benefits: Since we initiated the changes to the infrastructure of the boiler house and the steam lines we have managed to effect a saving in the hospital coal consumption of 48% from 2009 to 2015.
- Environmental benefit: The environmental benefit has been significant as we are now using far less coal for the amount of steam required to ensure that the hospital operates efficiently and effectively. Not only do we now produce less carbon emissions but as a result of the increased reticulation efficiency we are also using less water to produce steam and as a result, less water treatment chemicals.
- Human health benefit: This can be measured in the reduced physical load on the staff in the boiler house as well as the possible reduction of respiratory ailments of the people living and working in the surrounding neighborhoods.
- Other quantitative results can be seen in the reduction of steam leakages, water consumption, water treatment, less spent on maintenance, fewer shutdowns and lower electrical consumption of the boiler house.

The Issue

The functioning of the boiler house and the steam reticulation was inefficient and in need of a complete overhaul and modernization.

In order to keep up with the hospital "steam demand," the boiler house was running two 8 ton boilers at 6 tons of coal per hour in winter and 4,5 tons per hour in summer. This was deemed to be excessive as the history of steam production showed that it was possible to provide all of the hospital steam requirements with only one boiler "on-range" at a time.

The Groote Schuur Hospital boiler house was built with four 4 ton coal fired boilers in 1965, which replaced the original steam generation system installed in the old hospital basement in the late 1930's. In the mid 1990's three of the four 4 ton boilers were replaced with two 8 ton coal fired boilers and one of the 4 ton boilers remained.

With the three boilers installed the idea was that one boiler was to be "on-range", one "on stand-by" and one "off-range" for maintenance. This system worked well until about 2003 when the effects of just enough maintenance to pass the statuary 3-yearly inspections started to become noticeable as the system became less and less efficient.
The results of this extremely focused and limited maintenance meant that the boilers became filled with soot and fly ash, as the induce draft fans and soot separators in the smoke room of the boiler house were so full of holes that they had little to no effect on the soot extraction. The limited maintenance extended to the steam reticulation which, as a result had a defective steam trapping system as well as many leaks.

As this limited maintenance continued, the load on the boilers increased due directly to the

excessive leaks on the steam reticulation as well as the faulty Condensate Return System. With the returning condensate not being equal the steam output, more and more make up water was being added to the system. This resulted in the increased consumption of boiler water treatment chemicals and lowered the temperature of the water that was being fed into the boilers, in turn requiring more coal to be burned in order to make up for this lower feed water temperature.

The continued high coal consumption led to less stored coal, frequent break-downs of the coal delivery conveyors that are responsible of the delivery of coal from the coal storage bunker to the boiler coal feed hoppers. As the coal conveyor system was designed for stop-start operation and not almost continuous operation, the break downs were frequent. During the break down of the conveyors, a bucket brigade was needed in order for the continuation of steam production. At times, after hours, this bucket brigade could not be formed in time and steam production stopped, sometimes for a few hours. The knock on effect was that the hospital cooled down as the steam was used for the production of domestic hot water, space heating, cooking and sterilizing, meaning that once steam pressure was restored the load on the boilers was even higher.

Heavier steam loading on the boilers equaled more coal consumed producing more smoke and soot which polluted the surrounding areas with visible and invisible particulate matter.

Sustainability Strategy Implemented

The strategy that was used to address the issue of excessive steam usage and inefficiency of the boiler house and the steam reticulation at Groote Schuur Hospital was one of the most simple Engineering Strategies that is known to Engineers the world over - First Principles.

We initially went back to the hospital records to gain a deeper understanding of the original design of the steam reticulation and the design and thinking of the boiler house.

Once the design drawings had been studied the physical assessment and walking of the entire steam reticulation was carried out. During this physical assessment of the steam lines faulty trap sets, leaks, redundant legs, the condensate return system and deteriorated lagging were identified and logged.

With this list of faults in hand, aspects of the repair list were divided up and handed to the Mechanical Department of the Engineering Department at Groote Schuur Hospital. Having split the Mechanical Department into teams and providing specific tasks from the repair list to each team, we were able to develop a sense of competition which gave ownership of the tasks to the teams. The rivalry between the teams ensured that the projects were carried out correctly and with a good turn of speed.

The “First Principles” approach was used here as we were and are limited in terms of resources both financial and human. The First Principles approach ensured that we were able to complete many of the repairs in-house and that we are able to maintain the system with staff who are dedicated and skilled tradesmen. This taking back of ownership of the Hospital Engineering Systems has the added result of reduced after hours breakdowns and lower costs all round, coal, water, time, chemical, downtime, less waste generation in the form of ash and lower staff turnover due to illness.

Implementation process

The success of the implementation of this project hinged entirely on the expertise and technical strengths of the artisan staff of the mechanical and electrical departments of Groote Schuur Hospital. The continued effectiveness of this project relied on the continued motivation of the Engineering teams responsible for the upgrades and improvements carried out on the steam reticulation in order to increase the overall efficiency of the installation.

The staff did not require any technical training as all of the improvements to the system were based on the most simplest of engineering principles. As we were applying First Principles, very few modifications were required as the system was stripped of all complex management and obsolete systems and simplified to allow for the re-installation of the original steam systems on the steam lines and improvements to the Steam Generation Plant.

These improvements to the steam lines comprised of:

- Re-lagging
- Replacement of faulty steam valves
- Repair of steam leaks on flanges, valves and equipment
- Removal and blanking of all redundant steam lines
- Replacement of faulty condensate trap sets
- Re-lagging of condensate lines
- Removal of dead condensate legs
- Replacement of condensate return tanks
- Replacement of hot well tanks.

The improvements to the Steam Generation Plant comprised of:

- Complete overhaul of all boiler valves and fittings
- Re-lagging of boilers
- Sand blasting of boiler tubes and flues
- Replacement of soot separators and induced draft fans
- Installation of variable speed drives on the stokers and force draft fans
- Replacement of original boiler controls with new up-to-date control panels but retaining the non-PLC control method for ease of maintenance
- Complete upgrade to the boiler house electrical reticulation in order to eliminate redundancy and to become compliant with all current electrical regulations.

The success of this series of conjoined projects may be attested to the drive, passion and inspiration of the Engineering Department staff who were pivotal in the identification, writing of specifications and roll out of the actual projects.

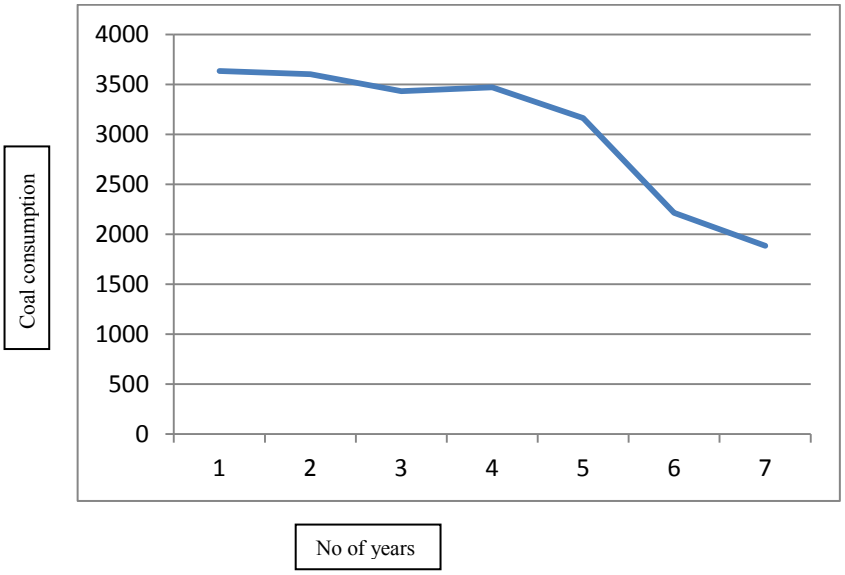
This drive and passion for Green Engineering had to be instilled, ignited and nurtured and this was possible only by the direct hands-on management that the Head of Engineering at the Hospital showed.

This project, initiated by the Head of Engineering at Groote Schuur Hospital was the stepping stone to many other “go green” initiatives started in 2009.

Results:

Over a five year period, the coal consumption at Groote Schuur Hospital reduced by 48% and the efficiency of the system improved from 30% to 78%.

Graph: Coal consumption from 2009 to 2015 at Groote Schuur Hospital



The reason for the implementation time was primarily due to financial constraints.

Challenges and Lessons learnt:

The success of this project showed the importance of asking the right questions, for example, "Why are we using so much coal and why is it costing us so much?" This question sparked a full investigation as described above, unearthing over a decade of maintenance neglect and thus an overall energy efficiency of about 30%, which the Head of engineering found unacceptable and through simple maintenance and a lot of elbow-grease a more acceptable efficiency could be achieved.

The Head of Engineering also sought advice and insight from his staff on how improvements could be effected. This interaction stimulated a drive to improve within the Engineering Department Management which filtered down to the General Staff.

Once the Saving drive started and gained momentum more and more projects started to emerge. These projects were prioritized and listed in order that they were implemented at the correct time in the larger overall efficiency improvement project.

The project showed in order to truly become "Green" one must first fully engage and motivate the Staff who are employed on site to maintain the Engineering Systems and Services of the institution.

The main challenge was the availability of finances, but the project nevertheless progressed at a smooth pace. Keeping many of the sub-tasks in house assisted in reducing these costs and this had the advantage of allowing for the technological development of the staff involved. This, together with allowing for their own individual development, motivation and morale to improve, resulted in seven staff members who are now qualified as full Artisans.

Next Steps

With a well-functioning system, further steps to improve the infrastructure of the steam reticulation will be limited to routine maintenance in order to gain the absolute peak efficiency in steam consumption, thus continuing to reduce our carbon foot print year after year. The added benefit to the reduced costs to the hospital would need to be recognized and quantified.

Demographic information

Groote Schuur Hospital is an academic hospital situated in Observatory, Cape Town, South Africa, linked to the University of Cape Town, UCT as the teaching facility. Groote Schuur Hospital is a public facility of 975 in-patient beds offering specialist and subspecialized services to the population of the Western Cape and beyond.

The hospital is situated on 19 hectares of ground and is 15 stories high, including the Engineering Service Floors situated between each patient floor. The services are provided in many buildings on the estate, all requiring maintenance from the Engineering Department.

3762 staff are employed within the hospital providing health services on a 24/7 basis. Of this number only 73 staff belong to the Engineering Department, covering Engineering Services from Clinical Engineering (Health Care Technology, 12 Engineering Disciplines) to General Engineering Services (25 Engineering Disciplines).

As Groote Schuur Hospital is one of two Academic Hospitals in Cape Town it is involved in out-reach programs that extend to local and international health institutions throughout Africa. These programs are not only for medical and nursing care, because the Groote Schuur Hospital Engineering Department is making in-roads by opening up communication channels between clinicians, hospitals and private enterprises such as the Global Green and Healthy Hospitals (GGHH) initiative and hopes to make an impact with the services it can offer and share.

Quotes:

BE FIRM,
BE FAIR,
BUT ABOVE ALL,
BE FUN.

The author of this document, Mr. Denton Smith, is the Head of Engineering at Groote Schuur Hospital and as such serves as a member of the Executive Management of the Hospital. He was appointed into the post of Engineering Head in 2011 aged 33.

Mr. Smith has a National Engineering Diploma in Electro Mechanical Engineering as well as a Post Grad Diploma in Advanced Project Management but his strongest, most powerful qualification is a passion for Hospital Engineering and a drive to make Hospitals efficient.

Mr. Smith wishes to convey his thanks to Dr B Patel the CEO of Groote Schuur Hospital for her continued support in the quest to “GO GREEN”