Tri-Gen and Co-gen – Installation and Commissioning issues

AIRAH Division Meeting 10th August 2011

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ACKNOWLEDGEMENTS

- AE SMITH - mechanical contractor
- FLOTH services design engineers
  - Proponents of Cogeneration based on the Greenstar and Nabers
- LEIGHTON PROPERTIES Developer and supporter
- LEIGHTON CONTRACTORS – Builder

AGENDA

PROVIDE AN OVERVIEW OF THE CONTROLS ASPECTS OF CO-GENERATION AND TRIGENERATION:

- **External and system issues**
- **What control issues occur with the equipment?**
- **What are the important aspects of control between the Chiller and the generator?**
- **What key control functions should be incorporated?**
- **What are additional control functions to enhance performance of the systems?**
- **Some examples of current installations and their controls**

COMBINED HEAT AND POWER

External Issues?

- Gas connections
- Gas pressures
- Sign off by inspectors as their requirements can differ from inspector to inspector
- Electrical separation from gas meter monitoring -Intrinsically safe environment
- Council Noise restrictions – normally 18:00 through to 06:00
- Environmental Emission restrictions – UREA treatment considerations.
- Noise/Vibration breakout from Generator plant rooms.

COMBINED HEAT AND POWER

What control issues occur with the equipment?

- If not able to export power back into the grid, having the load to run the generator to full load. (Winter loading/Load Bank positioning)
- Power shut down issues in a tenanted biulding. This may effect their day to day operation’s, call centres or server rooms. (essential power requirements)
- Load shedding profiling – to minimise the generators from stalling
- If the generated power is sold as essential power sourcing for tenants – changeovers sequencing is critical –UPS +ATS
- Plant Run On Capability on Absorber shut-down – Dilution mode (~45 minutes or longer)

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COMBINED HEAT AND POWER

What are the important aspects of control between the Absorber Chiller and the generator?

- Selection of Absorber/Generator matched thermal outputs./inputs
  - I.e. kWe of Generator to match kWr of Absorber.
  - Stable electrical load profile
  - Gas Burner Top-up of Absorber when Gen-set out of service or at part electrical load

- Design Workshops with both Absorber and Generator suppliers to fully understand equipment control requirements

- Equipment selection of CW ancillary devices e.g. Heat Exchangers to match required loads plus safety margin.

- Allow plenty of BMS temperature measuring points.

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COMBINED HEAT AND POWER

What key control functions should be incorporated?

- Absorber Burner Control via Absorber ?
- Exhaust Diverting Valve Control via Absorber ?
- Low Temperature Hot Water Cct diverting valve (Control normally via Absorber)
- Turbo intercooler cooling circuit (valve Control via BMS/Absorber)
- Waste Heat Bleed-off circuit
- UPS on Generator Control Circuit

COMBINED HEAT AND POWER

What are additional control functions to enhance performance of the systems?

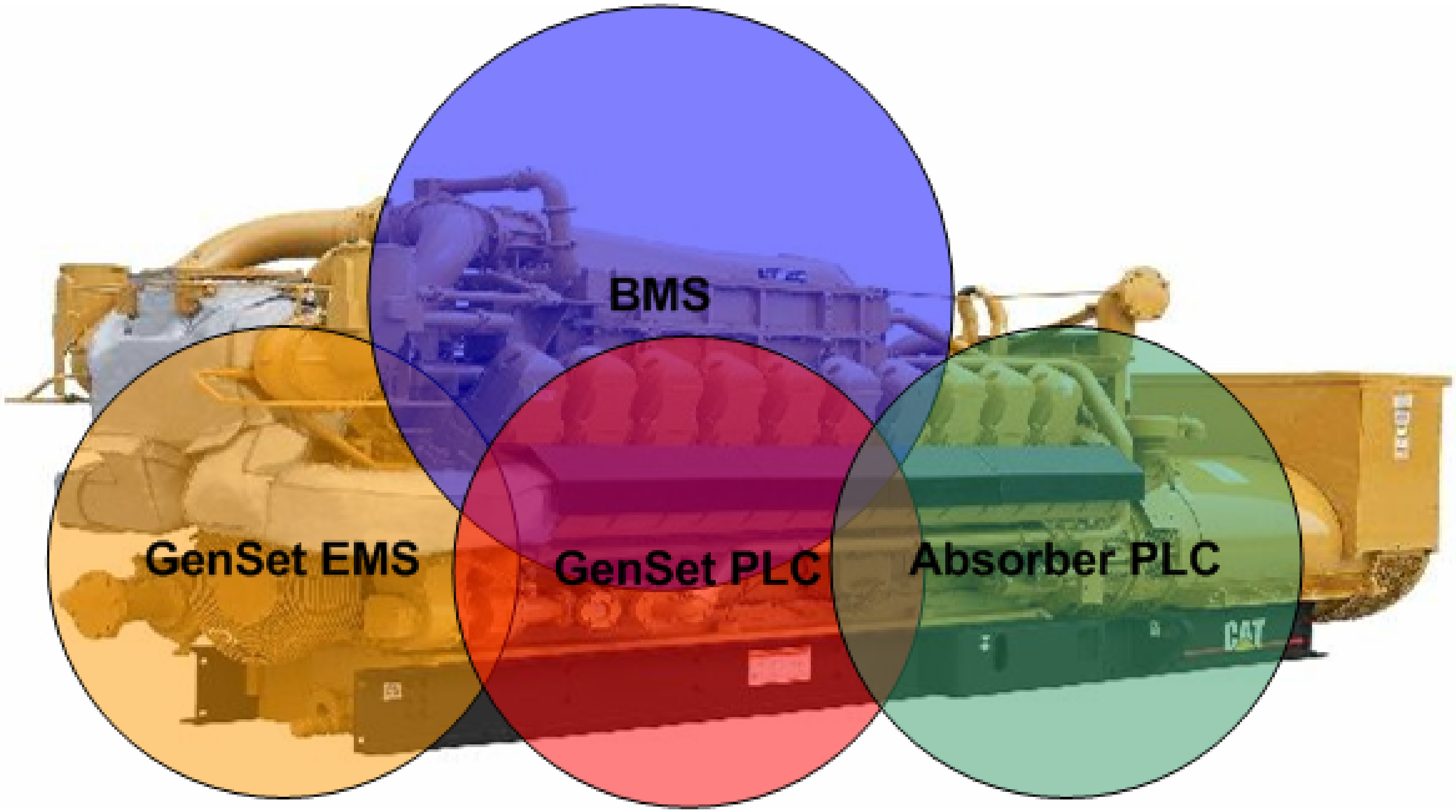
- Requirement to de-couple Absorber Condenser water to achieve higher temperatures at the Absorber, compared to lower temperatures normally required at Centrifugal Chillers. Thereby permitting application of advanced cooling tower optimisation algorithms to enhance Centrifugal Chiller COP's.

- Decoupling and advanced control methodology of generator heat rejection from jacket water and Turbo Intercooler. (refer to CW schematics.)

- Black start heat rejection considerations. Valves / pumps

- Ensure minimum loads present prior to Generator Start (bore glazing)

CONTROL SYSTEM INTEGRATION



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COMBINED HEAT AND POWER

Some examples of current installations and their controls

- 4 x Slides on Memory stick

Questions???

COMBINED HEAT AND POWER

- COMMON NAMES
  - Cogeneration
  - Tri-generation
  - Total Energy Systems
- BENEFITS or OBJECTIVES
  - Improved energy efficiency
  - Reduced greenhouse gas emissions
  - Reduced overall cost of energy

COMBINED HEAT AND POWER

CHP VIABILITY

1. Drivers
   - Energy cost reduction
   - Greenhouse gas reduction
     - Energy Efficiency Opportunity Legislation
     - NABERS / Greenstar Rating
     - Carbon Pollution Reduction Scheme????
     - Corporate Image
     - Improved rental return
     - Mandatory Disclosure
   - Constant Thermal Load
   - Electrical Constraints
     - Supply utility network upgrade avoidance
     - Security of Supply
     - Redundancy

CHP VIABILITY

1. Electricity to Fuel Price Ratio (spark gap)
   - The cost of electricity compared to the cost of fuel
   - The cost of input fuel needs substantially less than the cost of electricity

2. Heat to Power Ratio
   - The amount of site thermal energy use compared to electrical energy use
   - Needs to be large enough to sustain the use of heat recovery
   - Cogeneration is only viable if the waste heat of electrical generation can be effectively used.

3. Marginal Cost of Generation
   - Will determine when it is cost beneficial to operate the system

COMBINED HEAT AND POWER

IMPORTANT CONSIDERATIONS

- DESIGN
  - SCOPE BOUNDARIES
    - Where does the system sit?
    - Can central energy plant be divorced from CHP plant?
    - How are the ongoing and changing energy and cost balances best managed?
  - ELECTRICAL PROTECTION
  - POWER EXPORT POTENTIAL
  - NOISE & POLUTION
  - SPACE

- OPERATIONAL
  - ANNUAL MAINTENANCE COSTS
  - SERVICING SKILL BASE
  - LONG TERM RELIABILITY / AVAILABILITY
  - SHUTDOWN REQUIREMENTS

COMBINED HEAT AND POWER

GENERAL POINTS OF AWARENESS

- The technology used is more complex than that of an ordinary thermal system, because of the electrical aspects and separation from the network. As a result, installing and operating these systems requires expertise in both heat and electricity.
- CHP demands a larger investment than standard thermal systems to obtain the same thermal capacity.
- The technology and equipment are constantly being expanded and updated, notably with regard to their energy efficiency
- The initial estimate of electric and thermal needs is crucial for ensuring that the facility has an appropriate structural design. If this level of need changes in any way, the facility will become improperly sized and therefore potentially less efficient and profitable
- Changes in the price of fuel by comparison with that of electricity can have a rapid impact on the facility’s profitability, in a positive or negative direction.