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Multi-User Heating and Cooling Plant in South America
Cogeneration Around the World
Condensate Metering
St. James Centre, Edinburgh, Scotland

by John Barlow
Community Heating Services, BP Oil

At the East End of Princes Street, near the intersection with the top of Leith Street, and just north of Register House, is a large modern complex. This complex is designed to integrate with the mature Edinburgh stone buildings, is a link between the past and the present day.

Although ideas of developing the Leith Street site were considered as far back as 1937, it was not until 1960 that a shopping and commercial complex was seriously considered.

At that time this area of the city was mainly tenement blocks at least two hundred years old and in a dilapidated condition. As there were a number of ownerships—the Crown, the local authority and some private concerns—it was soon clear that the participants would have to get together to decide on a comprehensive scheme for development.

Over the following two or three years the town council acquired the necessary various properties, but in 1963 decided that the interests of the city would best be served by offering the site for open competition among developers. There was a proviso that whatever was planned would adjoin a very large Government office block, which the Ministry of Public Buildings and Works had planned for its part of the site. The complexity of the scheme naturally created some delay, and by 1967 the scheme still had not reached an acceptable stage. About this time it was decided to add to the commercial scheme an hotel with 154 bedrooms, 80 shop modules, a multi-story car park, and an electrical sub-station all on a site of approximately six acres. The main contract commenced in March 1970 for the construction of the whole development, and was completed in 1974. The main building contractor was Sir Robert McAlpine and there were six main contracts. These contracts were for the Government Office Block, Ravenseft and Murrayfield; John Lewis Partnership; Scottish and Newcastle Breweries; Shell Mex and BP centralized boiler house and distribution mains and South of Scotland Electricity Board.

The St. James Centre—as the commercial shopping precinct was called—is one hundred yards from Princes Street, and there is easy access via a pedestrian ramp. The Ravenseft and Murrayfield Scottish Developments covered mall occupies some 2800 m² and comprises a development of 60 shops and two banks on either side of the covered pedestrian mall. This is served with air heated by six air-handling plants. Access to the mall is from St. Andrews Square bus station and a pedestrian footbridge, as well as from Princes Street.

The John Lewis store main entrance is also at the covered mall level; this is one of the largest stores in Edinburgh with a turnover of £10 m a year and employing some 600 people. There is trading on four floors, and the whole store is capable of being fully air conditioned.

The King James Hotel, owned by Scottish and Newcastle Breweries, has an entrance from the shopping precinct, while the main entrance is from Leith Street. The hotel is on six floors and is double glazed throughout.

At the precinct level there is the main entrance to New St. Andrews House, the name given to the Government office block when it was opened by the Queen in July 1975. This is the headquarters of the Scottish Office which houses six Government departments—Central Services, Scottish Home and Health, Scottish Education, Scottish Development, Scottish Economic Planning and Agriculture and Fisheries—and in which are employed some 1300 people. The building has a suite for the Secretary of State for Scotland and for the Ministers of State. All the offices are comfort con-
ditioned, and there are 12 conference rooms on the floor below; individual controls of the heating and humidity levels can be applied in the main suite. Built in the form of a rectangle, the elevation from precinct level of New St. Andrews House varies from seven to nine storeys with the Minister's suite being on the top level. There is access at ground level from New St. Andrews House to the shopping precinct and secondary access to the bus station, Princes Street and the car park.

The shops, stores and Government office block are all serviced from a two-lane road running under the entire development at basement level. Also in the development is a six-story car park capable of storing 560 vehicles served by a spiral access ramp. Inside the central core of the ramp is water storage for the sprinkler systems for the car park and shopping areas.

Across from New St. Andrews House, and also connected to the district heating scheme is the General Register House. This was the first purpose-built public records office in the United Kingdom, and was designed by Robert Adam and opened in 1788.

Shell Mex and BP commissioned Ian Hunter and Partners to design a scheme to provide the central boiler plant and distribution mains to the respective plant rooms of the clients. Although it was recognized originally that the central boiler plant would eliminate a number of boiler plants and chimneys, it became apparent also that a better load utilization factor would result because of the varying needs of the main clients.

The department store and Government office block have heating and cooling requirements, and by using absorption refrigeration units fed from the high-pressure hot water mains instead of conventional compressors, a potential noise problem was avoided and a substantial summer as well as winter load was provided for the boilers. The variation of heating and cooling loads, daytime, evening and weekend requirements, together with fabric protection of buildings, enable the central plant to operate more efficiently than a number of small boiler units.

The boiler house for the development is situated in the basement of the centre occupying an area of some 600 m². It is bounded on two sides by Government office service areas and stores, and is approached from the main service route which runs through the centre of the development linking the west and east areas.

The oil tanks serving the boiler house are positioned adjacent to the boiler house and are of 150,000 litres capacity, with two sides of the concrete tank incorporated into the buildings retaining wall.

Access to the tanks is from a service landing approached from inside the boiler house. An inspection pit in the boiler house allows access to the oil outflow heaters, and is approached by means of a vertical cat ladder. Site distribution pipework runs for the most part in a purpose-built service tunnel, access to which is from inside the boiler house, with the exception of the mains serving the Government offices, which run at high level in the adjacent service road.

Three 5.8 MW oil-fired economic-type, three-pass shell and tube boilers of the “Clansman” type manufactured by Clarke Chapman/John Thompson, provide high-temperature hot water at 148°C which is then utilized as the primary heat source in the various heat exchanger stations providing low-pressure hot water to the other parts of the complex. In the flow headers from each boiler, automatic valves are fitted which maintain a circulation through the boiler when one is in stand-by condition.

The three boilers are fed with heavy duty fuel oil by means of a ring-main circulation system. Oil is drawn from the two storage tanks by a duplicate oil pumping unit with stand-by pump, which circulates the oil in a ring-main running in the floor trench to the burner. The burners are equipped with Hanworthy modulating rotary cup burners utilizing 3500 sec. oil. Oil heating is achieved by outflow heaters, also fed

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Meaningful comparisons from one period to another require information on weather (degree-days), changes in production, occupancy levels, types of fuels used, etc. In order to get certain needed information, you may have to install additional meters. Individual units may not now have meters to indicate electricity or fuel consumption.

The meters themselves have an additional benefit. Experience has shown that the simple act of metering often results in enhanced energy awareness and conservation.

Metering, measuring, accounting, and analysis of energy consumption all constitute an important first step, but action is called for to develop an energy-efficient operation. This means management, good management, concerned management. Such management dictates the absolute need to identify one individual within the organization as the energy manager or coordinator, who is specifically responsible for managing energy and improving energy efficiency. In larger firms, each operating division or plant should have its own energy coordinator. In the small firm, the energy coordinator may also be the general manager.

A word of caution here. All too many firms, large and small, designate someone as the "energy czar," send him off, and assume that he or she is solving the problem. If top management doesn't hear from the energy manager, they assume he has no problems. However, that is seldom the case. More often than not, the production chief tells the energy manager he can't reduce his energy consumption without reducing productivity, or the maintenance man says he is getting all he can out of the boilers. The energy czar then looks for some housekeeping energy conservation improvement opportunities, makes them, and reports back to his boss that all is being done that can be done. In fact, he has barely scratched the surface.

To ensure that energy managers do what they are paid to do, they must have the full support and backing of top management. Everybody in the company must know that the energy manager has total access to operating records, costs, and, of course, all senior executives. And top management must continuously push for more hard data, more recommendations, and tighter analyses.

The full support of top management is crucial. Mr. Morris has said, "You have to get the CEO and, if necessary, conduct him physically through the plant. Until you bring the problem and all its ramifications to his attention, the game of 'let's pretend we are saving energy because top management doesn't know a Btu from a can of beans,' will continue."

Does energy conservation and energy efficiency pay? Yes! Just ask anyone who has an active energy efficiency program. The Carborundum Company reports that its units, whether factories, warehouses, shipping operations, or offices, achieved significant energy efficiency and profit improvement very soon after implementing their energy accounting and analysis system. One large office building reduced fuel consumption for heating by 36% just by lowering the temperature to the point where no one was tempted to open the windows.

But you do not have to be a Carborundum or an IBM or an AT&T to realize financial gain from improved energy efficiency. In this case what is good for the "Fortune 500" companies is just as good for the corner market or the low-rise apartment building. The numbers may be different, but the incentive is the same and so is the potential for relative profit improvement. While the levels of sophistication are different, the procedures are the same.

I'd like to conclude with a quote from the March-April 1978 Harvard Business Review: "Many companies have saved more than 30% of their energy costs since 1974 and have thus gained a significant advantage on product costs. In those companies that have achieved substantial savings, top management has always seemed to be present . . . One may reasonably choose to blame the confused energy picture on bureaucrats and politicians and do very little about energy productivity until that picture clears up. However, it may be just as reasonable and substantially more competitive to conclude that, regardless of national policies, the facts of the energy situations are clear enough to warrant high-priority attention—now, not later."
by pneumatically actuated dial gauges. Tank contents
gauges are indicated on the panel and in addition, at
the remote oil filling points.

The products of combustion exit from each boiler
through mild steel flue pipes which connect to, and
run in, a vertical builders work stack. The insulated
flues are manufactured by Beaumont and are each 52 m
long and 685 mm bore and have hand-operated dampers
fitted to each flue duct to enable the boilers to be
isolated for maintenance purposes.

In order to achieve the design flow temperatures,
the system is pressurized by a "WARMAC" unit to
10.5 bars. This consists of a spill tank, duplicate feed
pumps, pressure modulator and integral control panel,
all housed in a paneled supporting framework. The
unit has automatic control facilities controlling the
switching of the back-up pump to take care of the
general pressure loss through valve, glands, etc. An
alarm system is initiated should a low-pressure condi­
tion be reached.

The main circulation is divided basically into the two
separate systems: one of which serves the Government
office block and Register House; with the other system
servicing the John Lewis department store, the King
James Hotel, and the shopping mall. The direct-drive
centrifugal pumps, (one duty, two stand-by), circulate
high-pressure hot water through the site distribution
mains running at high level in the boiler house and the
adjacent service access areas, to the heat exchangers
and other plant in the Government office block and
Register House plant rooms. The pumps are arranged
for "cascade" operation under the influence of the
return water temperature controls. Two similar pumps,
(one duty, one back-up), circulate high-pressure hot
water to the heat exchangers and other plant located
in the respective buildings. Either pump can be selected
as the duty pump, and automatic controls ensure the
back-up pump starting to meet requirements. A
separate pump is installed to act as stand-by to either
of the above circuits should any of the duty pumps
fail.

Since the boiler house is situated in the basement,
three double-stage axial fans draw fresh air in from
outside and discharge it through a heater battery
mounted in the boiler house supply air duct to supply
the boiler combustion air requirements. Automatic
controls ensure that the optimum supply air tempera­
ture is maintained within the required limit, and the
fans are additionally interlocked with the boilers to
ensure operation when the boilers are running. Attenu­
uators are fitted on both sides of the fan sets to ensure
quiet operation.

The 200 mm high-temperature hot water mains in
the boiler house drop from high level to the respective
pump sets; and discharge via a 150 mm supply to the
Government office block and Register House, and via

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the receiver. In such an arrangement, the turbine performance resulted in accuracy commensurate with conventional condensate meters, the primary device was not limited by temperature (rated to 700 deg), could be installed in any position, and was read at a convenient remote location. Problem areas are the pumping, required level control sequence and allocation of power costs. The obvious thought that occurs in such an arrangement is that once the turbine meter establishes the volume between the level switches in the receiver it could be replaced with a simple digital counter—and that is something to think about.

Conventional condensate meters have the power required to drive contact devices, and the present meter manufacturer has such an accessory available. This is useful as a remote register, as input to an energy monitoring system, or to determine demand. A few words of caution, however, in that demand recorders are becoming far more sophisticated, and dwell time of the contacts is important. The cassette tape units work better at an equal on/off cycle. That is, for 100 pounds registered, the contacts should be closed for 45 to 55 pounds and open the remainder, or vice versa. Another source of demand errors with slow moving condensate meters is bouncing or chattering of contacts; it is surprising to find that many “snap” switches do not operate electrically “clean” and some work with an oscilloscope may save a billing dispute.

In summary, condensate metering of steam is the most popular method of billing for that form of energy. The meters, properly installed and maintained, are remarkably dependable and accurate. Condensate metering cannot be used for some steam use that is popular and profitable, such as direct humidification, pressing, and other garment trade operations. It is often difficult to condensate meter absorption air cooling equipment. We must remember that in condensate metering accuracy of billing, not accuracy of measurement, depends on the customer’s return system and it is the on-going responsibility of the utility to monitor that system.

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a 200 mm supply to the King James Hotel and the John Lewis store where they split into two 100 mm supplies. The supply to the hotel and store run in a conventional duct under the service road to the respective plant rooms. Both off-takes are fitted with control valves to ensure that the correct volume of water is circulated to each plant room to meet demand.

The supply to the Government office block feeds the main plant room calorifiers and absorption chiller units to provide secondary hot and chilled water to the various equipment rooms, and thence to the eight separate zones and the 2200 heating and cooling units. Chilled water is supplied by 2 x 866 kw Dunham Bush units and four heating calorifiers rated at 1800 kw each to provide hot water. There are six storage domestic hot water calorifiers rated at 550 litres each, situated in small plant rooms around the building.

At one time Register House had its own boiler house, but the building is now connected into the scheme via 150 mm mains. The old boiler house is now one of the three calorifier stations for the building, each containing two non-storage heating and one domestic hot water storage calorifier.

The whole of the John Lewis store can be air conditioned; and air is distributed throughout by an extensive ducting system, the return air being brought back for recirculation with a proportion of fresh air to suit prevailing conditions. Chilled water is provided by two Trane absorption refrigeration units rated at 880 kw, each using the high-pressure hot water generated in the boiler house. The domestic hot water requirements are met by three calorifiers; two at 1820 litres for the kitchens, and one at 3200 litres for toilet hand basins, etc.

The King James Hotel bedrooms have individual radiators, while the public rooms are fed by fan convectors; hot water requirements are met by two 8000 litre calorifiers.

The covered mall takes pressure hot water direct to the six Trane air-handling units. The air intakes are at roof level, and the air discharges at high level to the covered areas below.

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Convincing top management in and out of your organization that central heating and cooling is a potential profit center, can reduce customer utilities costs, and is in the best social and economic interests of the community and the Nation, is the challenge you face. It is a challenge you should relish and take on with enthusiasm because the marketplace is on your side.

At the age of 101, the death knell is not tolling for district heating. Far from it. Rather, you have been splashed with the fountain of youth. And you can indeed face the future with confidence.

Let me make one final point: The solution to the energy problem doesn’t lie in the Congress or the Department of Energy. The solution rests with us...you and me and our neighbors. We must strongly resist the temptation to duck our responsibility and pass the challenge on to Washington. Let me quote from a speech Carla Hills gave recently:

“If we bank on vain hope that Washington will come up with answers that will spare us from taking personal action, we literally invite disaster. Because energy is so intricately involved with every facet of our lives, we will have passed to government an unprecedented control over our destinies.” I don’t know about you, but I don’t want any more government involvement with my life. I want less.

The Congress can provide some positive and negative incentives to change our behavior: they can give us tax credits for insulation; they can mandate automobile efficiency requirements; and they can provide other incentives.

But the Congress cannot legislate a change in people’s attitudes. We have to do that ourselves.

Each of the main plant rooms is provided with a Ranger instruments Aquametro heat meter at the point of entry to the premises. This point generally defines that at which BP Community Heating Services responsibility ends. These heat meters contain a differential sensing unit, a mechanical integrator, and double counters incorporated in the unit to enable the heat consumption to be measured.

The Community Heating Services Branch of BP Oil operate the plant and have entered into contracts with the main clients to sell heat to them on a two-part tariff. During the period of the contract, BP Community Heating Services are responsible for the continuity of heat supply and for all aspects of maintenance and replacement of plant as necessary.

The Community Heating Services engineers provide routine maintenance to the plant, and operate a planned preventive maintenance system to ensure that each item of equipment is maintained at optimum efficiency. They also provide coverage on a 24-hour basis to the plant, utilizing the company’s own Datofon-
At the present moment when Britain is harvesting the enormous reserves of North Sea oil, and when even future prospects for coal seem more hopeful with the discovery of the Selby coalfield, one may be tempted to think that the nation can afford the CEGB. This is a fallacy, because none of the fossil fuel reserves will last forever. At the same time, high home heating costs have a very adverse effect upon living standards, while the fact that the British manufacturer has to pay through the nose for his electricity, reduces the profitability and competitiveness of British industry. It must be recognized that the establishment of the CEGB, which in its overall structure is a unique type of organization throughout the entire capitalist or communist world, was probably a mistake. The sooner something is done about undoing this blunder, the better for all of us.

References
Numerous articles and papers in journal, Fernwarme International, Stresemannalle 23 6000, Frankfurt 70, West Germany.

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ic Monitoring Service. This plant, in common with all larger plants operated by BP, is monitored from the master console via a G.P.O. landline. The boiler house unit monitors the likely critical alarm conditions (up to a maximum of 20) and in the event of a malfunction sends a call via the G.P.O. line to the central console; this is received and given a visual, verbal and type-out record of the condition. The engineer is then contacted to attend to and rectify the fault.

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