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"OTELLO" System Overview (Heat Engine)

Exclusive OTELLO Licensee:

- OLAER International Group / Preferred Supplier for all Parts OLAER can supply worldwide are mainly the "Bladder and or Piston Accumulators" www.olaer.com

OLAER GROUP

1. INTRODUCTION

The *Otello* system is a waste heat recovery power generation system currently under development by *International Innovations Limited* (IIL) www.internationalinnovations.com.au and its collaborative partners *Olaer* *www.olaer.com* . The *Otello* technology is the latest addition to the family of waste heat recovery and power generation systems owned by IIL. The system was protected by European patent during March 2008. This document provides an overview of the *Otello* technology, including a description how the system works and its beneficial features, and a discussion of possible early applications of the product.

2. HOW "*OTELLO*" *heat engine* WORKS

The *Otello* system is a method for converting energy from a heat source into a more useful form, such as electricity. *Otello* has been designed to recover energy from low temperature heat sources in the range +35 ^{o}C to +150 ^{o}C. The principle that drives *Otello* is that a closed vessel containing a fluid will become pressurised when it is heated. With an appropriate fluid, high pressures (31bar, 47bar , 75bar and 112bar) can be reached at the available temperature and selection of gas. This high pressure can then be used to drive a machine, thus converting heat energy into useful mechanical energy.

Critical to the performance of the machine is the selection of a working fluid that generates sufficiently high pressure from the available heat source. The fluid selected for *Otello* at +35C is liquid CO2 in closed sealed system has a critical point at +31.1C and 75bar pressure. Then is a refrigerant known as R410-A, which, at temperatures in the critical point 72^{o}C can generate pressure 47 bar and change to NH3 gas and 132C can produce 112bar or +150C use R245FA = 31bar, all are in closed sealed OTELLO system. A key aspect of the *Otello* system is the use of bladder accumulators with restrictor (supplied by *Olaer, see last page*), which are pressure vessels containing a flexible bladder that divides the total volume into two separate chambers. In *Otello*, the refrigerant is heated and pressurised inside one chamber of an accumulator, and this high pressure is then transferred to a hydraulic medium (such as oil or water) inside the bladder. This produces a flow of high pressure hydraulic fluid, which can be used to run a machine. It is this process that allows the *Otello* system to convert thermal energy into mechanical energy. The *Otello* therefore has two main systems: (1) a Refrigerant Circuit that controls the heating, pressurisation and circulation of the gas, and (2) a Hydraulic Circuit that converts the high pressure generated by the gas into a useful mechanical output, as shown in Figure 1.

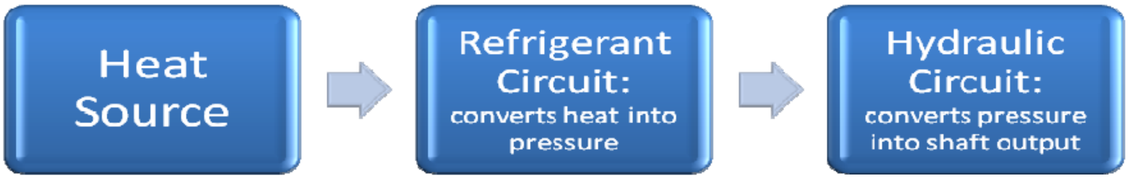

Figure 1 – Otello includes a Refrigerant Circuit and a Hydraulic Circuit.

2.1 ACCUMULATORS AND OTELLO

Hydraulic accumulators are important components in the operation of the *Otello* system. Accumulators provide the link between the Gas Circuit and the Hydraulic Circuit, and perform two critical functions. These are: (1) heating and pressurising the gas, and (2) transferring power (pressure) from the gas to the hydraulic medium. The physical layout and orientation of one accumulator is shown in Figure 2. The Bottom Chamber is plumbed into the Refrigerant Circuit and the Flexible Bladder is connected (via the top port) to the Hydraulic Circuit. Thus, the Bottom Chamber contains gas and the bladder contains the hydraulic medium (water or oil). See last page modification by OLAER.

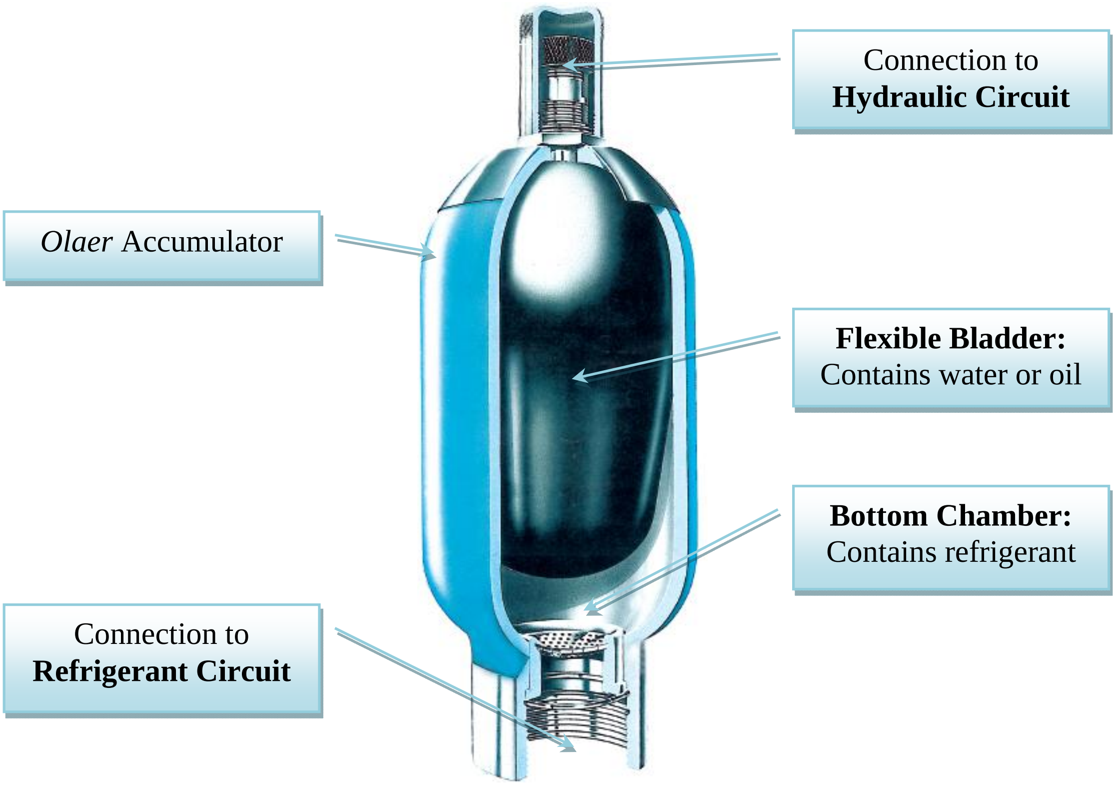

Figure 2 – Accumulator orientation and layout (not to scale).

The standard bladder from OLAER can be filled with fluid/oil and expand to occupy the complete volume inside the pressure vessels. When calculating the volume required for the rate of flow in the fluid circuit OLAER bladders can be fitted with a restrictor (see last page) for the volume limit required when filled with water or oil to the required ratio between GAS side & FLUID side in order to minimise stretching and prolong service lifetime. Best of all is HONEYWELL valves and controls can monitor and control the appropriate volume of fluid into the bladders. At the beginning of the heating/pressurisation process, with the bladder filled to 30 – 50 %, the bottom chamber is partially filled with low temperature, liquid gas. With both the top and bottom ports closed, heat is applied to the accumulator. This causes the chosen gas / refrigerant to increase in temperature, vaporise, superheat and – most importantly – increase to its critical pressure. After a period of time, when the gas has reached its sufficiently high pressure (31 bar to 112 bar), the top port is controlled to opened by design or Honeywell controls and the water or oil is expelled from the bladder under high pressure. In this way, the accumulator facilitates (1) the heating and pressurisation of the gas, and (2) the transfer of this pressure to the hydraulic medium. It is this function that is most important to the operation of *Otello*.

2.2 WATER BATH

In order to provide a continuous output of high pressure hydraulic fluid, it is necessary to have multiple accumulators heating/pressurising and discharging in a time-shifted manner. The accumulators are housed in an array that is enclosed in an insulated steel vessel, as shown in Figure 3. The total number of accumulators will vary depending on the desired power output. In the example shown, which is from a 50 kWe system, the total number of accumulators is 21, arranged in a 3 by 7 array. Importantly, the steel enclosure is filled with water, meaning that the accumulators are completely submerged in a water bath. The heat source is used to maintain the temperature of the water bath at the highest possible value. For temperatures above 100 ^{o}C, additives such as Glycol may be used to raise the boiling point, or the water may be replaced with another fluid (such as thermal oil with a boiling point of 400 ^{o}C) in order to prevent boiling. This arrangement is convenient because there are many existing systems for transferring heat from a heat source to a liquid medium. For example, there are existing commercially available diesel engine exhaust heat exchangers that provide hot water at the required temperature. These heat exchangers can easily be directly connected to the water bath to provide heating. One target for market is for cold climate countries to focus on +35^{o}C waste heat with LCO2 = 75bar pressure. Next up is to use refrigerant R410A and +72C heat, and produces good working pressure 47 bar for mechanical work for making clean electricity. Other gas / referigents like NH3 and +132C heat = 112bar & +150C use R245A.

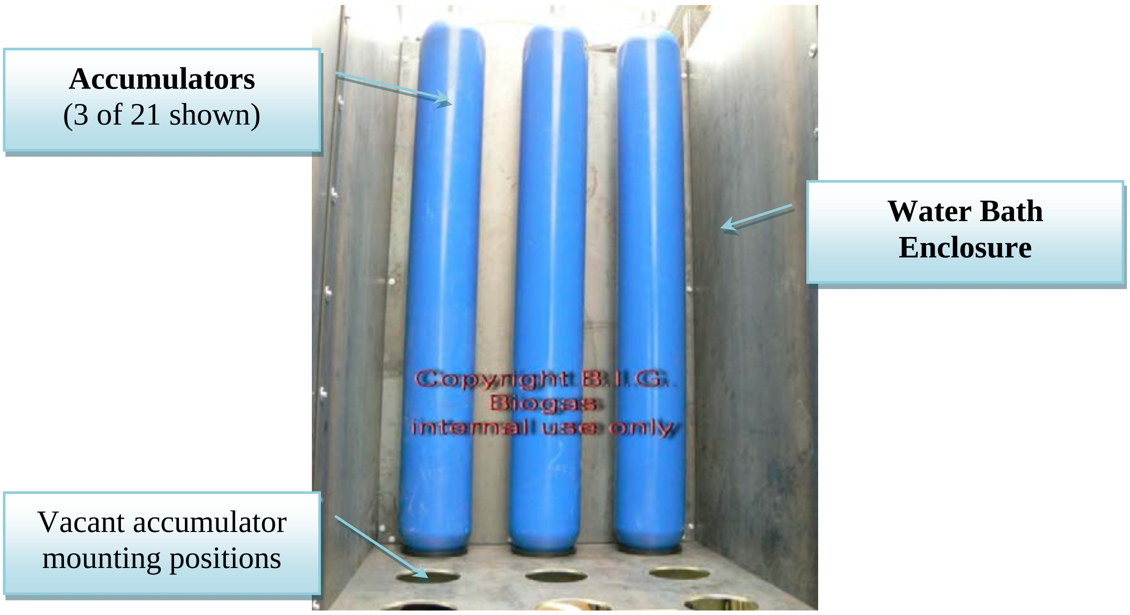

Figure 3 – The Otello *Water Bath.*

The accumulators in the first built OTELLO were completely submerged in the hot water bath and therefore are continuously heated over their entire surface area. It is now considered only the gas side needs heating and the bath can be built to only cover the bottom half of the OLAER pressure vessels level with the gas and below the bladder or piston. During the heating and pressurisation of the gas (described in the previous section), the heat input is from the hot water bath, through the entire outer shell of the accumulator. The hot water bath may be stirred (with an impeller, for example) to increase heat transfer rates, in the same way as a 'fan forced' oven does for hot air. The hot water bath also provides a large thermal reservoir
that will tend to dampen out fluctuations in input temperature, and will allow the *Otello* to generate power for some time after the heat source becomes unavailable.

2.3 OTELLO SCHEMATIC

The *Otello* schematic is shown in Figure 4. As is shown, the system is compatible with any heat source that is capable of maintaining the desired temperature of the water bath. More details are provided in the following sections on the operation of the Gas / Refrigerant and Hydraulic Circuits to support the continuous operation of *Otello*.

2.4 REFRIGERANT CIRCUIT (R410-A)

The purpose of the refrigerant system is to facilitate the heating and pressurisation of the R410-A, and then to 'reset' the R410-A for the next cycle after it transfers power to the hydraulic fluid. As the first step in the cycle, shown in Accumulator 3 in Figure 4, liquid R410-A is pumped into the bottom chamber of an accumulator, partially filling it. The accumulator is then sealed, as shown in Accumulator 4, and the R410-A is given time to heat and pressurise. After reaching its maximum temperature and pressure, the R410-A then transfers power to the hydraulic system, when the top (bladder) chamber of the accumulator is opened, as shown in Accumulator 1. The expanded R410-A is then vented from the bottom chamber into the remainder of the refrigerant circuit, as shown in Accumulator 2. At this point, the R410-A is a hot vapour at high pressure. It then passes through an expander, which drops the pressure, and then through a radiator, which causes the R410-A to condense back to the liquid phase. This closes the cycle and the liquid R410-A returns to the refrigerant pump and back to the accumulators. In this way, as the R410-A moves through the refrigerant circuit, it receives heat energy as an input, and transfers mechanical energy (pressure) to the hydraulic fluid inside the bladder accumulators as an output.

2.5 HYDRAULIC CIRCUIT (WATER OR OIL)

The purpose of the hydraulic system is to convert the pressure generated by the gas into a useful form, such as mechanical energy in a rotating shaft (which can turn a generator to make electricity). As shown in Accumulator 2 in Figure 4, while the gas is being vented into the expander, the bladder at the top of the accumulator is simultaneously filled with hydraulic fluid (water or oil). The pressure to fill the bladder is supplied by a pump downstream of the hydraulic turbine. The bladder is designed to approximately 30 % to 50 % of the total accumulator volume. The bladder is then sealed (and its volume remains constant) as the bottom chamber is filled with gas and pressurised as described previously, until the maximum temperature and pressure is reached. Then, as shown in Accumulator 1, the bladder is connected to the hydraulic circuit, and the water or oil is expelled from the accumulator under high pressure and driven through a liquid turbine (or other hydraulic motor). After passing through the turbine, the liquid then returns to the accumulators for the next cycle. The hydraulic fluid is maintained at a temperature similar to the water bath, in order to minimise thermal losses. No phase change occurs in the hydraulic circuit; the fluid remains liquid throughout the entire process. The use of multiple accumulators allows the flow of high pressure hydraulic fluid to be maintained continuously to drive an Oil Motor or Pelton Turbine to generate electricity.



More photos of OTELLO built in Germany see IIL website in products or click on the following link http://www.internationalinnovations.com.au/otellophotos.php

OTELLO technology:

- Lowest heat requirement in the industry from +30C to +130C using bladders and as high as +200C using pistons accumulators from OLAER International Group,
- MODULAR, Flexible and scalable from 1kW to any size using OLAER pressure vessels with bladders or pistons from 0.01 litre to 500 litre for +130C heat and 112 bar pressure. Build 10MW by connecting in cascade design i.e. 10 x 1MW OTELLO's or 100MW by connecting 10MW x 10, whatever until all waste heat energy is used for optimum efficiency. Change the refrigerents / gases to suit the temperatures as they drop from OTELLO consumption to make clean electricity,
- Lower cost compared to ORC / turbine generators and higher efficiency because OTELLO can actually connect to these to use the waste heat energy. Why not just use OTELLO???
- Lowest operation and maintenance requirements in the industry OTELLO, replace bladders, valves / switches – monitored by control system and planed maintance servicing periods as recommended by OLAER & HONEYWELL,
- Non-combustion process OTELLO,
- Zero toxic by-products OTELLO and qualifies for CARBON CREDITS?

- Zero emissions OTELLO,
- Zero fossil fuel requirements OTELLO,
- Modular and mobile OTELLO,
- Carbon neutral OTELLO,

OTELLO is modular and can be built to any size from smallest to largest power generation system OTELLO heart is using the following OLAER www.olaer.com recommended materials for heat and gas selection using a wide range of sizes:

- Refrigerent R410A and or Gas liquid CO use bladder material: Butyl (M40) -15°C to + 130°C
- Refrigerent R245FA use bladder material: Nitrile (M25) for - 15°C to + 110°C
- High Pressure Gas NH3, Anhydrous Ammoniac gas use bladder material: Polychloroprene (M50) for tempreture ranges - 15°C , +100°C
- **Also if we had to choose 1 compound as a compromise to suit all it would be Butyl (M40).**
- Piston Accumulators sizes range from: 0.01 litre to 500 litre for +130C heat and 112 bar pressure. The piston accumulators are flat ended for better sealing and can be fitted with "bladder or piston".
- Using "BLADDER" the smallest to largest flat ended steel pressure vessels but with using BLADDERS?

    0.16 litre @ 60mm OD to 50 litre @ 230mm OD as standard design + say 500 litre gas volume with additional 500 litre fluid section as Stephen's original set up (restricted bladder movement).

When we start looking at specifics I can supply more details.

Best regards

Christophe RIGAUDIE
Managing Director ASIA & PACIFIC

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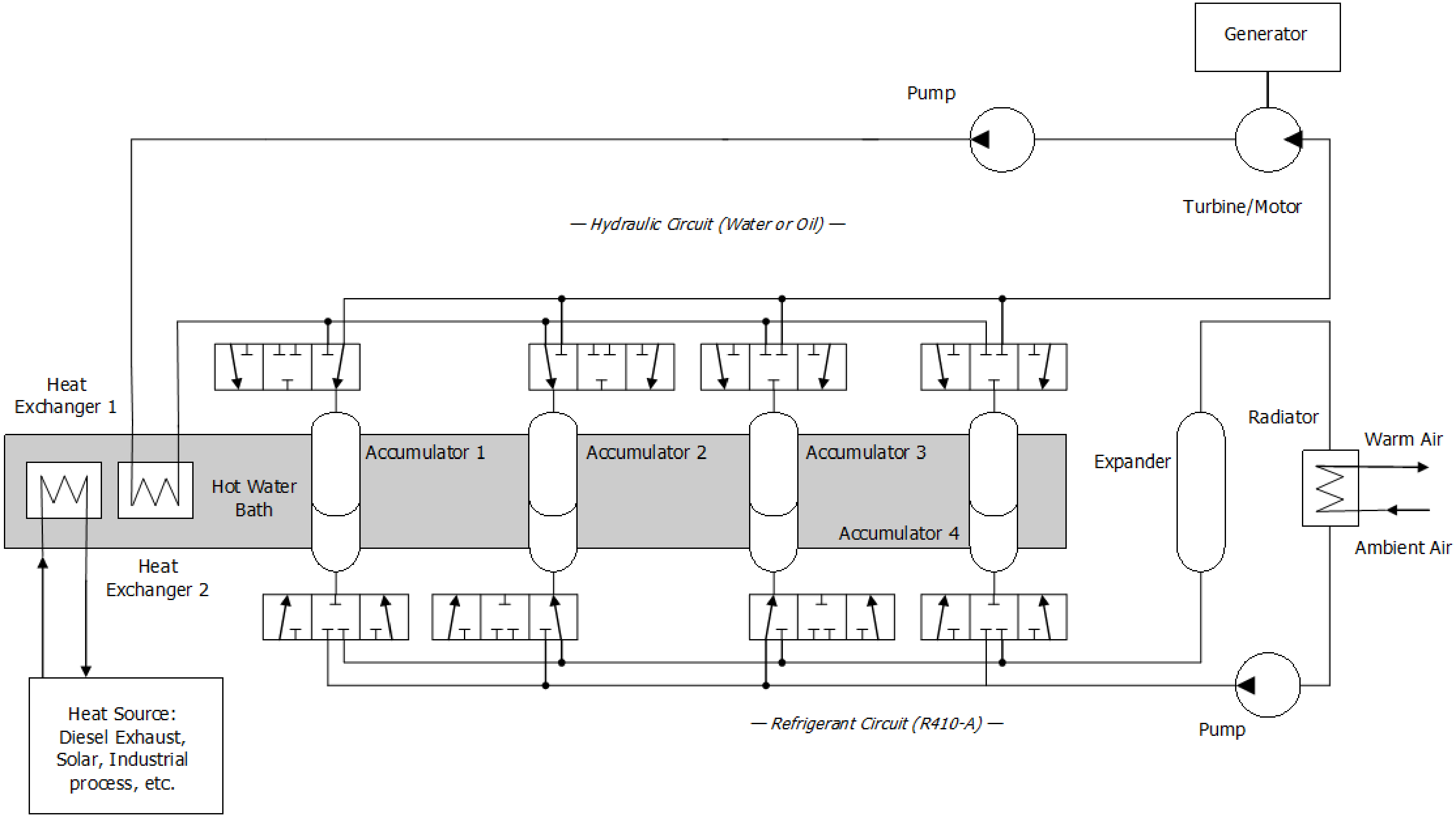


Figure 4 – Simplified Otello *Schematic.*

3. CONTROL SYSTEM

The operation of all the valves, pumps and other subsystems will be co-ordinated by an autonomous control system. The control system may take as inputs external information including electrical load, heat source temperature and ambient temperature, as well as information from within the *Otello* such as valve positions, fluid temperatures and pressures, and mass flow rates. The control system will have an embedded software program that takes these (and, likely, other) inputs and produces logical outputs to ensure the continued, smooth operation of the *Otello* at the desired power output level. The control system will also have a communications link with a service computer (operated by, for example, the licensee for that region), for the scheduling of maintenance and other tasks. It is intended that the control system will perform these or other similar tasks:

1. <u>Run the *Otello* under normal operating conditions.</u> This will involve start-up, steady operation and shut-down procedures governing such events as valve opening and closing times, and the management and control of fluid flow. The control system software will change its outputs to dynamically respond to changes in heat source temperature, ambient temperature, load conditions and other parameters to facilitate the continued operation of the *Otello* under normal conditions.

2. <u>Detect any abnormalities and/or failures and compensate to allow the *Otello* to continue to produce power output.</u> For example, the control system may be able to detect when some subsystems are responding slower than usual, which may indicate a fault is about to occur. The system may be able to detect the failure of a valve or other component. In either of these (or similar) cases, the control system may be able to compensate by, for example, shutting down the operation of one of the accumulators in order to prevent further damage and allow the overall system to continue operation.

3. <u>Report any abnormalities and/or failures to the service centre via the communications link.</u> Any faults that are detected as described previously will be reported to the service centre via an automated telephone or internet communication. This will enable the automated scheduling of servicing, repairs, or replacement of parts. This would be critical to the development of a sophisticated ongoing maintenance and service program, which may be an attractive value-added product to be offered by local licensees.

4. <u>Report the number of kWh of electricity produced by the *Otello* system.</u> The control system may be used to periodically report the number of kWh of electricity that has been produced. This may be especially valuable for end users concerned with any form of *carbon auditing*, in which the output of the *Otello* must be carefully quantified in order to offset other carbon emissions, generate carbon credits, or redeem Government financial incentives for the generation of electricity in this way.

5. Upload new software to the machine from the service centre. If, at some time after the installation of an *Otello* system, some improvements are made to the control software, this can be passed to the control system via the communications link. It is foreseeable that continued testing, optimisation and service experience will lead to further development and sophistication of the control software. For example, it may be shown that the performance of the *Otello* can be improved by filling the bladders to a different percentage, or by adjusting the timing of some valves. With the communications link, these improvements can be immediately uploaded to all the *Otello* systems in operation, so that all systems, regardless of age, are kept up-to-date with the latest version of the control system.

In these ways, a sophisticated control system will add robustness and flexibility to the *Otello* system. It will offer many value-added products for the regional licensees, such as servicing or software updates, and will improve the outcomes for the end users, through improved performance, greater reliability, and extended system lifetime.

4. BENEFITS

The key advantages of the *Otello* system include:

1. The system is compatible with a variety of heat sources. Any heat source that can maintain the water bath at the required temperature from +30^{o}C and up is suitable. Further, the use of the water bath greatly simplifies interfacing with the heat source. Many commercially available heat exchanger systems will be suitable. For example, when the *Otello* is driven by the waste heat from diesel engine, a standard exhaust heat exchanger could be used to heat the water bath. The same *Otello* system could be used in other applications by merely replacing this heat exchanger with one compatible with the heat source (gas-liquid heat exchanger, liquid-liquid heat exchanger, etc.). This modular approach will tend to reduce the cost of adapting the *Otello* system to different heat sources.

2. The system can easily be adapted to suit different temperature limits. Within the constraints of material compatibility, the system can accept a variety of working fluids in the Refrigerant Circuit, hydraulic media in the Hydraulic Circuit, or heat transfer fluids in the water bath. These fluids can be selected to ensure the best match for the heat source temperature and local average ambient temperature. Depending on material compatibility, standard hardware may be sufficient, since the layout of the fluid circuits is independent of the specific choice of working fluid. This will lead to greater standardisation, which will tend to reduce costs and manufacturing complexity. For example, the same physical components may be suitable for applications in both Europe and Africa; these systems may simply need to be filled with different fluids to ensure optimal performance under the different local conditions. Also, refrigerant fluids are under continual development by their manufacturers, so as new products become available, with extended lifetimes, less environmental impact or improved thermal properties, these new fluids may be compatible for immediate use in existing *Otello* systems in service.

3. The refrigerant is heated while it expands. This tends to maintain the temperature and pressure. Heating the working fluid while it is expanding is thermodynamically ideal and, for example, is incorporated into the high efficiency Stirling and Ericsson cycles. Even in large power stations, this can only be approximated, because, due to engineering practicality, steam cannot be heated whilst it is passing through a turbine. In that case, the process is approximated by reheating the working fluid in discrete steps, in between separate expansion processes.

4. The expansion process occurs slowly. This is a closer approximation of an ideal, 'reversible' process compared to some other systems, which tends to increase efficiency. The slow operation of the system will also tend to extend the fatigue life of some components and minimise or delay degradation of the bladder materials.

5. The use of bladder accumulators is likely to result in a highly efficient expansion process. Using the accumulators in this way to pressurise water or oil and drive a liquid turbine is likely to recover approximately 70 % or more of the motive power produced by expanding the refrigerant. Liquid turbines typically have efficiencies of over 90 %. In contrast, for a vapour turbine operating under similar conditions, this efficiency may be as low as 30 %. This gives *Otello* a significant advantage over many competing low-temperature waste heat recovery technologies, such as Organic Rankine Cycles. In addition to a possible efficiency advantage, the use of bladders to expand the refrigerant also removes a common engineering problem associated with the use of vapour turbines. Vapour turbine blades suffer from erosion if the working fluid condenses during the expansion process. This will not affect the bladder system, and the expansion of a wet vapour is unlikely to have any negative effects. This makes the bladder system more robust against changes in operating conditions than vapour turbines.

6. The system can be assembled from commercially available, off-the-shelf components. In contrast to vapour turbine systems, *Otello* requires no specialised parts. Instead, *Otello* can be built from robust components that each has their own history of product development and optimisation, and years of proven service (decades of service in the case of the accumulators). This will tend to extend maintenance lifetime, as the *Otello* will inherit the reliability and maturity of its individual components. Further, the use of commercially available parts will tend to reduce the cost of the machine through (a) minimising product development costs built into the final price and (b) making use of the existing manufacturing, mass-production and assembly techniques already in place for each of the components. This feature may also simplify maintenance procedures and reduce maintenance costs through existing familiarity with the various components.

5. APPLICATIONS

As has been noted, the *Otello* system is highly versatile and compatible with a wide variety of heat sources. These may include:

1. Stationary Diesel, Gas or Biomass Generators: An early application of the *Otello* system was built in Germany claimed 24% efficiency and is likely to be in the recovery of the waste heat generated by stationary diesel generator sets. As an example, for a 500 kW diesel engine, a standard exhaust system heat exchanger can recover approximately 500 kW of waste heat, which can be used to power an *Otello*. With an optimised system operating at the maximum temperature of +150^{o}C, an additional increase in the output of the generator for the same fuel use (or similar reduction in fuel use for the same output) may be obtained. This system would be particularly attractive to the owners of stationary diesel generators that provide primary power (i.e. not emergency stand-by power). The system will become increasingly financially attractive as fuel prices continue to rise, and as either penalties for carbon emissions or incentives for emissions reductions are introduced.

2. Solar Thermal: Solar thermal power involves generating electricity using the *heating* effect of sunlight (as distinct from the photovoltaic effect). Concentrated sunlight can generate extremely high temperatures. Temperatures well in excess of 200 ^{o}C are common. The most mature solar thermal technology is the parabolic trough solar concentrator, in which a heat transfer medium (such as water or thermal oil) is heated as it passes through a pipe situated at the focal line of the concentrator. The heat transfer medium is typically used to provide heat input to a steam or organic Rankine Cycle system to generate electricity. However, the heat transfer medium could instead be used to provide heat input to the *Otello* water bath. This could be achieved either directly, by passing the heat transfer medium through the water bath, or indirectly, via a liquid-liquid heat exchanger. The *Otello* system may be advantageous due to its operation at lower temperatures. This may simplify the heat transfer system for capturing heat from the solar concentrators, by reducing pipe wall thicknesses, mitigating material/temperature compatibility issues, and reducing radiation losses.

3. Power Station: Conventional coal power stations waste heat through cooling/condensing systems has +35C hot water heading for the lake or river, in exhaust flue gasses +120C. For example, the exhaust flue gas temperature of the Kogan Creek power station in Queensland, Australia, is +120 ^{o}C. This waste heat can be captured and input to an *Otello*, through conventional heat exchanger systems. In addition to the increase in electrical output obtained, this would reduce the thermal impact on the local environment and, if heat is extracted from the condensing system, may also reduce the power scavenged by that part of the power plant. This would be especially the case at the Kogan Creek power station,

where heat is rejected through an air-cooled condenser in order to reduce water consumption. The trade-off is that this air-cooled system scavenges more power from the main plant compared to water-cooled systems. Therefore, using the waste heat from the cooling system in an *Otello* would not only allow the direct generation of additional electricity, but may also tend to reduce the power consumed by the air-cooled condenser, since would be a smaller heat rejection load.

4. Power Station / Solar: In some cases, such as those involving the recovery of waste heat upstream of the condensing system of a power station, the temperature at which energy is recovered may not meet the minimum requirements of the *Otello* system. In these cases, it may be favourable to use a solar concentrator field (such as the system described previously) to reheat the heat transfer medium to the minimum temperature required by *Otello*. This arrangement would greatly reduce the required size – and cost – of the solar concentrator field, compared to a stand-alone solar thermal power station of the same electrical output. This is due to the significant amount of preheating provided by the power station waste heat.

5. Geothermal Power: Geothermal power involves using heat obtained from underground to generate electricity. The *Otello* has two potential uses in this application. It could be used as a secondary system to capture the +140C heat wasted by a primary power generation system, such as a steam or organic Rankine Cycle, in a similar way to that described above for conventional power stations. Alternatively, the *Otello* could be used as the primary power generation system. Again, this may be advantageous where the temperatures obtained are lower than those that are suitable for other power generation systems.

6. Industrial: Clearly, the *Otello* system would be beneficial in many industrial applications where heat would otherwise be wasted. Some examples include cement plants, kilns and ovens, any furnaces, and processes involving steam (such as food and/or chemical processes). The installation of an *Otello* system into the process would require only the inclusion of a heat exchanger to recover the waste heat and transfer it to the water bath. Users could then capture some of their wasted energy to generate electricity, which would reduce fuel/electricity consumption, energy costs, carbon emissions and any carbon-related penalties.

6. COLLABORATIVE PARTNERSHIPS

In addition to overseeing the development and deployment of the *Otello* technology, IIL is currently in the process of bringing together a team of mature companies to facilitate the worldwide supply of parts and completed systems. The team currently includes the following members:

- International Innovations Limited (IIL): IIL is responsible for the ownership and maintenance of all intellectual property, including all improvements. IIL also acts as project manager and co-ordinator of product development programs.

- OLAER international group (visit: www.olaer.com): Olaer is the worldwide preferred parts supplier for the bladder accumulators – 'the heart of *Otello*' – and other products such as piston accumulators, coolers and radiators where possible. Olaer's global presence and supply chains will underpin the provision of *Otello* systems as the demand for waste heat recovery technology rapidly increases.

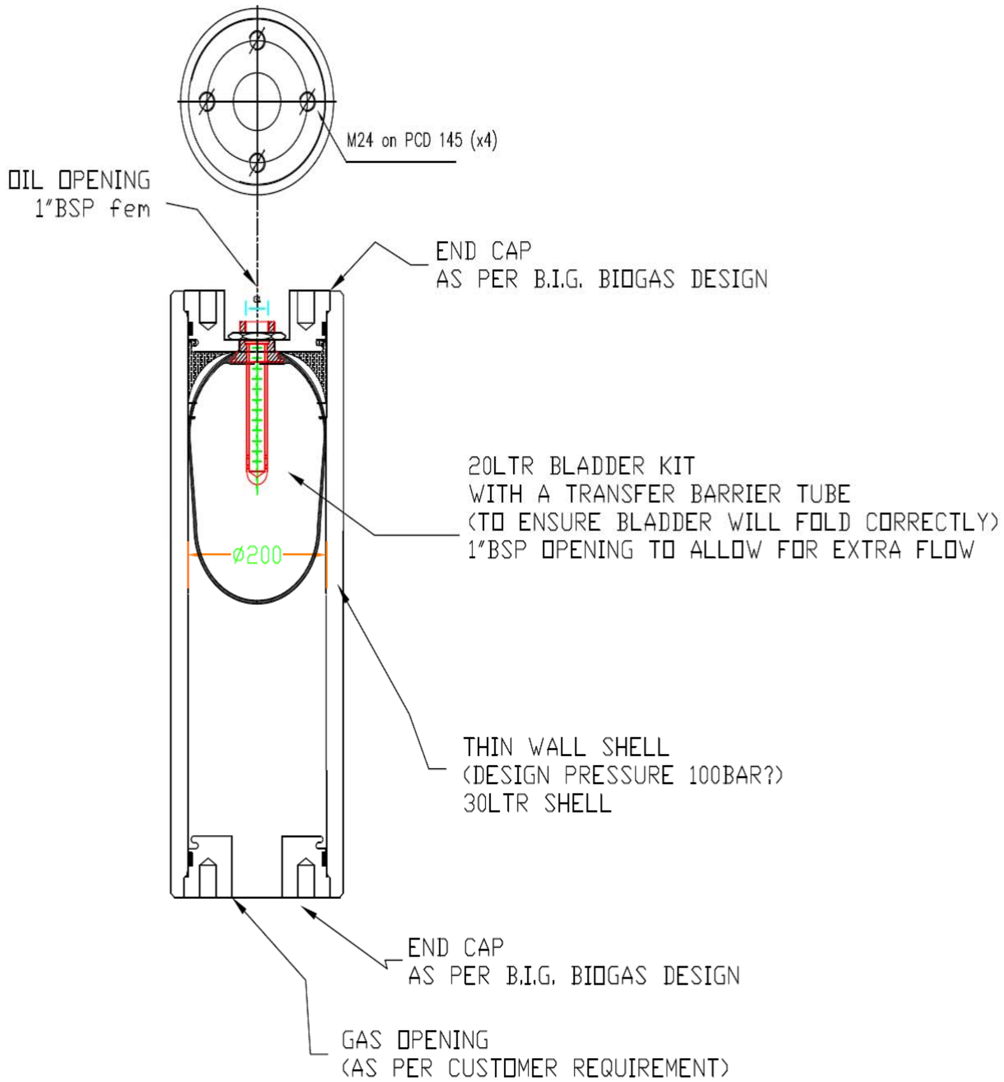
IIL is seeking collaborative relationships with potential partners relating to:

- License agreements for the sale, installation and ongoing servicing of *Otello* systems in all regions of the world.
- The supply of the secondary components of the *Otello* system that are not currently provided by *Olaer*.
- The development of large scale projects involving the capture of waste heat from existing power stations and/or the use of solar thermal concentrators to drive the *Otello* system.

7. SUMMARY

The *Otello* system is a versatile waste heat recovery technology that can generate electricity from a wide variety of heat sources. It is based on the expansion of a refrigerant inside accumulators to pressurise a hydraulic medium, which is then used to drive a liquid turbine. The accumulators are mounted in a hot water bath that can easily be interfaced with the heat source using common heat exchanger systems. The bladder system may have an efficiency advantage over vapour turbines under some operating conditions and it can be assembled from commercially available, off-the-shelf components. The *Otello* system could be applied to recover waste heat from stationary diesel generators, in solar thermal applications, to improve the output of conventional power stations, or in multiple industrial situations. In all these cases, the main *Otello* hardware would remain unchanged and standard, with only the heat transfer interface with the hot water bath being customised to the application. In this way, the *Otello* represents a low-cost, robust and attractive method for reducing fuel consumption, reducing carbon penalties and improving environmental sustainability. IIL is seeking collaborative partnerships with several international companies for the supply and sale of the *Otello* system, and is continually seeking to add new members to this highly competent team.

Next Page is illustration of OLAER Bladder/Restrictor modification for OTELLO



The above is the OLAER www.olaer.com modification for International Innovations Limited (IIL) 100% owner of OTELLO patents. This represents a bladder with restrictor for better fluid control & using the bladder NO PRESSURE DROP so better smooth flow to make mechanical work. www.honeywell.com with their valves and control system can manage the fluid circuit using standard OLARE bladders (or piston) accumulators, so we have two options for managing the volume of fluid in each bladder as calculated to control the required ratio of GAS for pushing the FLUID for the flow rate requirement for a Pelton Turbine + Generator.

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Written by Dr Nicholas Ward 3rd April 08 ,
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