Highest-level Effluent Treatment at Pirbright National Virology Centre

The £135m, state-of-the-art, laboratory, based at The Pirbright Institute, for research into and surveillance of virus diseases of farm animals and viruses that spread from animals to humans, required stringent levels of effluent treatment and containment across the whole facility. Suncombe were appointed to design, construct and commission this element of the project in conjunction with Shepherd Construction, the overall project leaders. The project was funded by the Biotechnology and Biological Sciences Research Council (BBSRC).

The BBSRC National Virology Centre has the highest containment level for animal pathogens (containment level 4) to enable the study of animal virus diseases exotic to the UK. The centre houses up to 150 scientists and support staff undertaking research on highly contagious viruses such as foot-and-mouth disease virus, African swine fever and highly pathogenic avian influenza viruses. It uses the latest bio-containment technologies, some developed specifically for the Institute. The facilities will help to predict and prevent outbreaks and develop vaccines and diagnostics.

Project Scope & Planning

Within the main building is a central hub with north, east and west wings which accommodate the bio-containment (level 4) laboratories. This large (11,065m²) and very sophisticated project demanded an extremely high environmental performance level, including reliability and redundancy. Following the construction and commissioning, Pirbright has a world-class centre of excellence for research into viral diseases of livestock, contributing to global food security and health, improving the quality of life for animals and people, it says.

Suncombe faced many challenges to meet the very tight parameters for effluent treatment and disposal. In order to assess the criteria, the company started by reviewing the initial building specifications and worked with the client to develop 3D models of the proposed effluent treatment plant (ETP) envelope. This envelope was dimensioned and modelled to allow ingress and emergency access for the effluent treatment equipment.

Design Stage

Following preliminary design, the stakeholders went through a process of design evaluation, HAZOPs and risk assessment, to jointly develop the optimum methodology for guaranteed effluent treatment at the containment level 4. Early in the project, performance testing was specified which could provide test results to prove the systems efficacy, as well as equipment demonstrations and strict timetables for testing and commissioning of the final system.

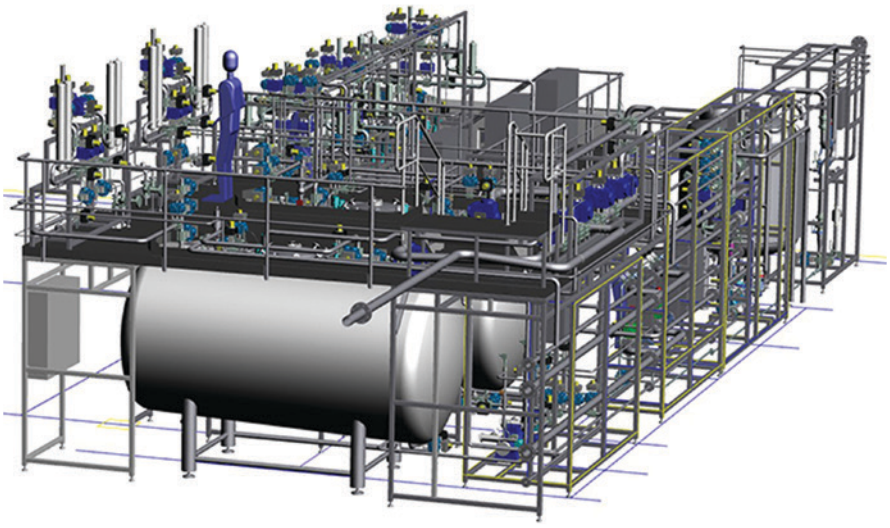
It was very important for Suncombe to identify all of the critical outcomes and the requirements of the statutory authorities, and use these as it developed the designs. This meant close co-operation with the client and developing clear understanding and communication with Suncombe's engineers, some of whom have been working on biowaste effluent treatment and critical decontamination and sterilisation systems throughout the company's more than 50 years of operation.

The entire ETP was designed and manufactured to CE, cGMP, PED, ASME, GAMP, ATEX standards. In addition the system design and construction needed to be successfully integrated into the building structure and with the other equipment and services involved in the laboratory infrastructure. Extensive pre-delivery tests were carried out to ensure that, on delivery to site, the system reconnection and preparedness for operation would be straightforward.

Construction & Testing

While the construction programme was finished on schedule, four weeks of factory acceptance testing were required, prior to delivery, carried out to the pre-approved testing protocols. System documentation and certifications were reviewed, as well as full testing including automation and dry run simulations, followed with wet testing and system thermal mapping and inactivation cycles.

Following delivery and installation, the testing regime continued with the next stage of site acceptance testing, once again to pre-approved protocols. Tests were carried



out to prove that the installed system maintained the operation of the factory accepted system and continued on to challenge testing and bio-deactivation testing.

Operation & Equipment

The ETP must operate within a complex network of negative air pressure systems, time-controlled barrier showers and multiple containment layers of unique construction materials to protect the outside environment. Water generated from laboratory activities, hand washbasins and showers is collected for treatment in waste collection tanks.

The project specified two 8000-litre collection tanks as a dual redundancy feature or to enable the laboratories to operate at high capacity. The double tank installation also enables the site to continue to operate at full capacity if one tank is taken out of service for maintenance or sterilisation.

As any water collected in the level 4 bio-containment facility can contain pathogens, it is vital that all tanks are sealed and filtered for both liquid and air ingress or egress.

Following waste collection, the waste is transferred to one of three 1100-litre treatment or kill tanks, where it is heated to the inactivation temperature for the inactivation time. Again the three tank facility enables one tank to be out of service for maintenance while the facility continues to operate at full capacity.

Dave Adams of Suncombe explains, “We offer systems that provide inactivation by chemical, thermochemical or thermal treatment. This system being at level 4 adopted a purely thermal approach, as recognised in the industry. The effluent treatment methodology was rated as safety integrity level 3 to ensure that there was no possibility of discharge of untreated waste.”

Following successful treatment, the waste is discharged to a cooling system which cools the waste to a predetermined temperature to suit the drain outlet temperature requirements. This cooling facility also included a quench back-up system using mains water in the event of coolant failure, to ensure continuous operation.

Safety Features

All pipework connecting the tanks, pumps, compressors and other equipment is made from a high grade of

stainless steel, in this case, SS 316 and Hasteloy (C22) duplex steel for corrosion-resistance.

The ETP has its own duty and standby air compressor system to ensure that any failure in the main laboratory air supply does not cause failure in the plant's operation. In addition, the entire system has a dedicated safety PLC to operate the safety circuit around the effluent treatment discharge.

Self-contained Unit

While this particular plant is housed internally in The Pirbright Institute Laboratories, Suncombe says it is able to supply a completely enclosed effluent treatment plant integrated into a shipping container which can be located anywhere on a site, without the need for additional construction. "The container is a stand-alone treatment facility," explains Steve Overton, operation director at the company. "All that is required is a secure pipework connection system for the effluent feed and discharge and connection of utilities," he added.

A Major Impact

Opening the facility in late 2014, the then Business Secretary, Vince Cable, commented, "Disease spreading from animals to humans isn't a plot from a Hollywood movie. Its results can have devastating impact on our health and the health of the countryside economy. This new centre will help protect both. Investment like this is why we are designing a long-term science and innovation strategy, which will help British science to keep breaking barriers."

Professor John Fazakerley, director of The Pirbright Institute, said: "Our new high-containment facilities have an exceptionally high standard of design and finish and will allow us to retain and recruit the very best expertise and continue to deliver high-impact science. The impact of the Institute's science is global."

Animal health and welfare research is crucial to our economy and society, says BBSRC. Pirbright has already played a vital role in saving the nation an estimated £480M, and protected 10,000 jobs in the rural economy during the last bluetongue outbreak, through their policy advice and forecasting of the disease threat.

The capabilities developed during this project mean that the Institute and its construction partners are now considered world-leading experts in high containment builds with technical leadership that is being sought by other countries.

A neighbouring centre will form a key part of the next phase of investment to deliver medium-level containment facilities – with a particular role in protecting the UK from bird-borne diseases such as bird flu, ensuring protection for the multi-billion-pound poultry industry.

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