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esa

# WATER MANAGEMENT

## Technology Transfer Programme

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*What do water management and satellites have in common? This brochure will help you find out, and tell you just how the European space industry is having an increasing impact on water management in general.*

*Several of the technologies used in the water industry come from systems that were developed for applications in space. I hope this brochure will give you an insight into how advanced European space technologies are being applied to our precious water, not only to improve its quality but also to make it always available.*

*Many innovative non-space products and services that will benefit society are now being introduced as a result of technological spin-offs from the space industry, and it is worth remembering that water management is not the only sector to take advantage of the new technologies developed by European space companies.*

*I hope this brochure will enable you to discover the new and unexpected ways in which space activities are improving our daily lives.*

As we move into the 21st century we are becoming ever more aware of the need to preserve the Earth's sensitive ecosystem, to minimise the harmful effects of our own activities on the environment, and to husband and conserve natural resources. Increasingly space technology is helping to supply the tools that enable us to do this.

Space systems and technologies have provided us with effective methods to monitor the impact of land and water use and development. Some of the underpinning space technologies have been adapted to improve the ways in which we exploit and manage the Earth's natural resources.

Pierre Brisson
Head of the Technology Transfer and Promotion Office

## KEEPING BUGS AT BAY

We take it for granted that the water flowing into our homes is clean and safe to drink. However, to maintain its quality, water-engineers are continually looking for better ways to remove harmful impurities. Now, advanced software developed for space engineering is keeping harmful bacteria out of our water supplies.

One serious biological contaminant is the common parasite Cryptosporidium found in water drawn from farmland where sheep and cattle graze. This bacterium causes a serious illness in humans known as cryptosporidiosis; in 1993 and 1994, it resulted in more than 100 deaths in two incidents in the US. Unfortunately, Cryptosporidium cannot be safely eradicated by chemical means, so water companies have to rely on a multi-layer filtering system known as rapid gravity filtration (RGF) – usually the final physical removal process in water treatment. The filter beds through which the water passes are designed to catch all solid matter and are regularly purged of contaminants, a process known as backwashing. This must be carried out with optimum regularity to ensure that the treatment works effectively. The efficient management of the filter beds and backwashing is therefore of paramount importance to the water industry.

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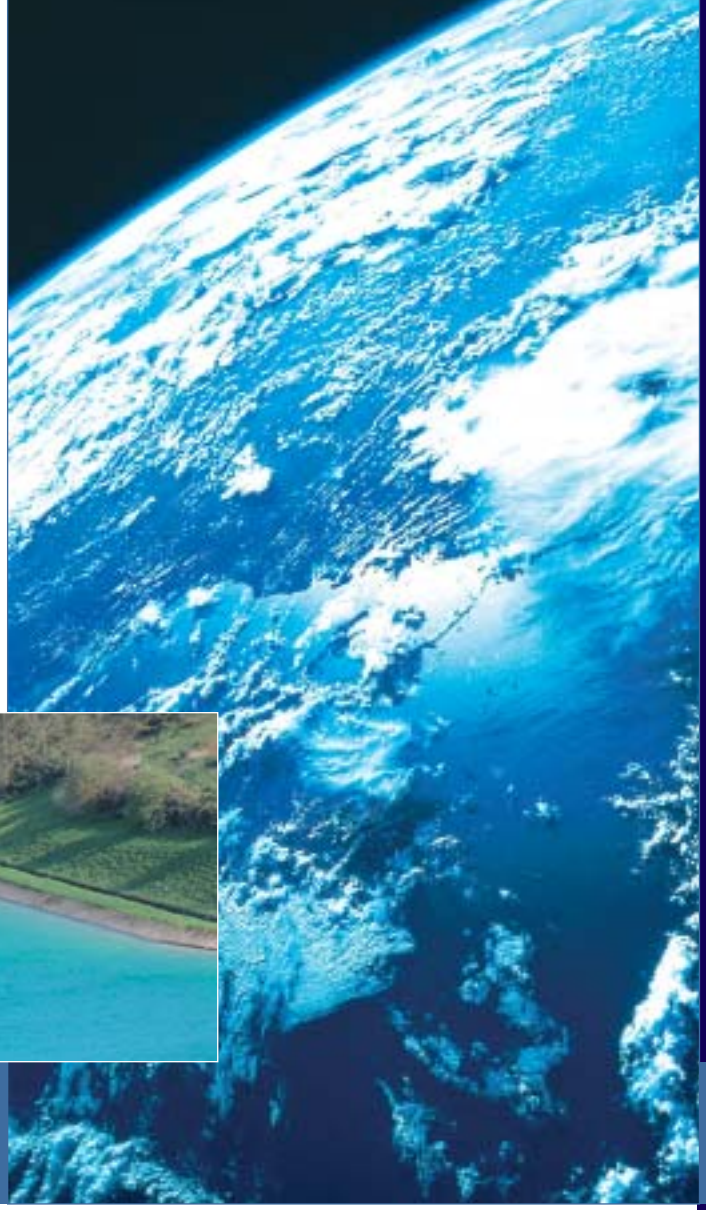
In order to optimise the operation of their water-treatment plants and so reduce the risk of Cryptosporidium contamination, Yorkshire Water, a water utility company in the UK, decided to model the filtration process on a computer using an advanced simulation programme developed by the software company Cogsys and based on the European Simulation Language (ESL) – a robust simulation software package developed for ESA over 20 years ago. Advanced space projects requiring accurate and robust computer simulation of dynamic systems have used ESL for many years, and now this same software is also being used to help ensure that our drinking water is kept free from unwanted parasites!

## FILTERING IN THE SPRING

Water is one of the largest consumable items by weight on manned spacecraft. On missions of long duration, the crew will consume many litres of water. To help reduce the amount of water needed to be launched from the ground, technologists at ESA's research centre in Holland have developed an innovative automated filtration system to recycle waste or 'grey' water into drinking water. This waste water may include the condensation that forms on the inside surface of the spacecraft, effluent from washing clothes and dishes, and also water



discharged from experiments and the life-support equipment.

One of the challenges of recycling waste water from a variety of sources is that it is difficult to anticipate what impurities will be present. It may contain, for instance, volatile organic compounds (VOCs) and also pathogenic microbes, both of which are notoriously difficult to remove. The system developed by ESA has proven to be highly effective at removing all types of contamination. It uses a series of membranes which filter out the various impurities from the waste water as it is pumped through them. Although limited to the astronauts' needs, the same concept can treat several hundred litres of waste water per hour.

Such has been the success of this system that it has attracted the interest of a major European bottler of spring water. The company concerned was looking for a filtration technology to help it overcome problems at several of the wells it was using as water sources. Water extracted from some natural springs can be discoloured as a result of high concentrations of minerals. This is a particular problem for water obtained from springs fed by hydrothermal wells. Trials carried out with the technology showed that the filtration system was highly efficient at removing these minerals and other impurities. The same filtration technology is now being considered for recycling waste water on ocean cruise liners.

## SPACE WORKS TO WATER WORKS

When we turn on the kitchen tap we don't think about how the clean water reaches our homes. Extracting, treating and distributing water across the nation is a complex business. In the UK, a single water utilities company may have responsibility for literally dozens of reservoirs, pumping stations and treatment plants, all of which are required to operate as an integrated network in order to meet the public's demand for constant fresh water.

With the privatisation and amalgamation of water utilities across Europe, individual companies have been forced to cut costs and devise new and ever-more labour-efficient ways of both monitoring and controlling their networks for water distribution. One of the problems they have had to address has been the wide geographical spread of the individual facilities – often sited on river banks or next to wells located deep in the countryside.

Unbeknown to the water companies, their needs corresponded quite closely – although on a vastly different scale – to those of satellite operators who have, since the start of space exploration, needed to devise systems to enable them to monitor and control spacecraft many miles from Earth remotely.

## AUTOMATED CONTROL

Science Systems is a UK company which first developed satellite-tracking systems in the early 1980s. An early product was a system called Kernel Telemetry Tracking and Command (TT&C) which formed the basis for a range of control equipment developed for satellites such as those of EUMETSAT and Telecom-2. Via telemetry links, using TT&C, data may be downloaded, systems status monitored and routine commands executed, allowing the day-to-day operation of the satellite to proceed largely free from the need for human intervention.

# Benefits for our daily lives: the ESA Technology Transfer Programme

Over the past 35 years, the European space industry has gained considerable expertise in building, launching, controlling and communicating with satellites. From this long experience of how to overcome the hazards and problems created by such a hostile environment, many valuable new technologies, products and procedures have been developed. Today, this expertise is improving our daily lives by providing many innovative solutions for products and services on Earth.

Groundbreaking European space technologies are becoming increasingly more available for development and licensing to the non-space industry through the process of technology transfer. The ESA Technology Transfer Programme has already achieved over 120 successful transfers or spin-offs from space to non-space sectors.

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It was Science System's desire to diversify into new markets, coupled with the privatisation of the water industry in the UK – and consequent release of investment funds – in the mid-1980s that led to the development of complementary computer-based systems which could be used by water companies.

These Supervisory Control and Data Acquisition (SCADA) systems, as they came to be known, have now been successfully adopted by several water companies, including Welsh Water, Thames Water and Lyonnaise Des Eaux. Like spacecraft orbiting the Earth, many water-company sites now operate highly effectively unmanned. Their status and serviceability is constantly monitored, and their routine operations are controlled remotely from a central operations centre serving several sites.

This success is reflected by the fact that since 1991 technology transfer has generated more than 20 million euros in turnover for European space companies and 120 million euros for the non-space industries involved. Already 2,500 jobs and 12 new companies have been created, with 25 expected by 2003.

The ESA Technology Transfer Programme is carried out by a network of technology brokers across Europe and Canada. Their job is to identify technologies with potential for non-space applications on one side, and on the other side to detect the non-space technology needs. Subsequently, they market the technology and provide assistance in the transfer process.

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**or visit the ESA Technology Transfer Website:** **http://www.esa.int/ttp**

**or the ESA-supported technology market places:** **http://www.technology-forum.com**

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