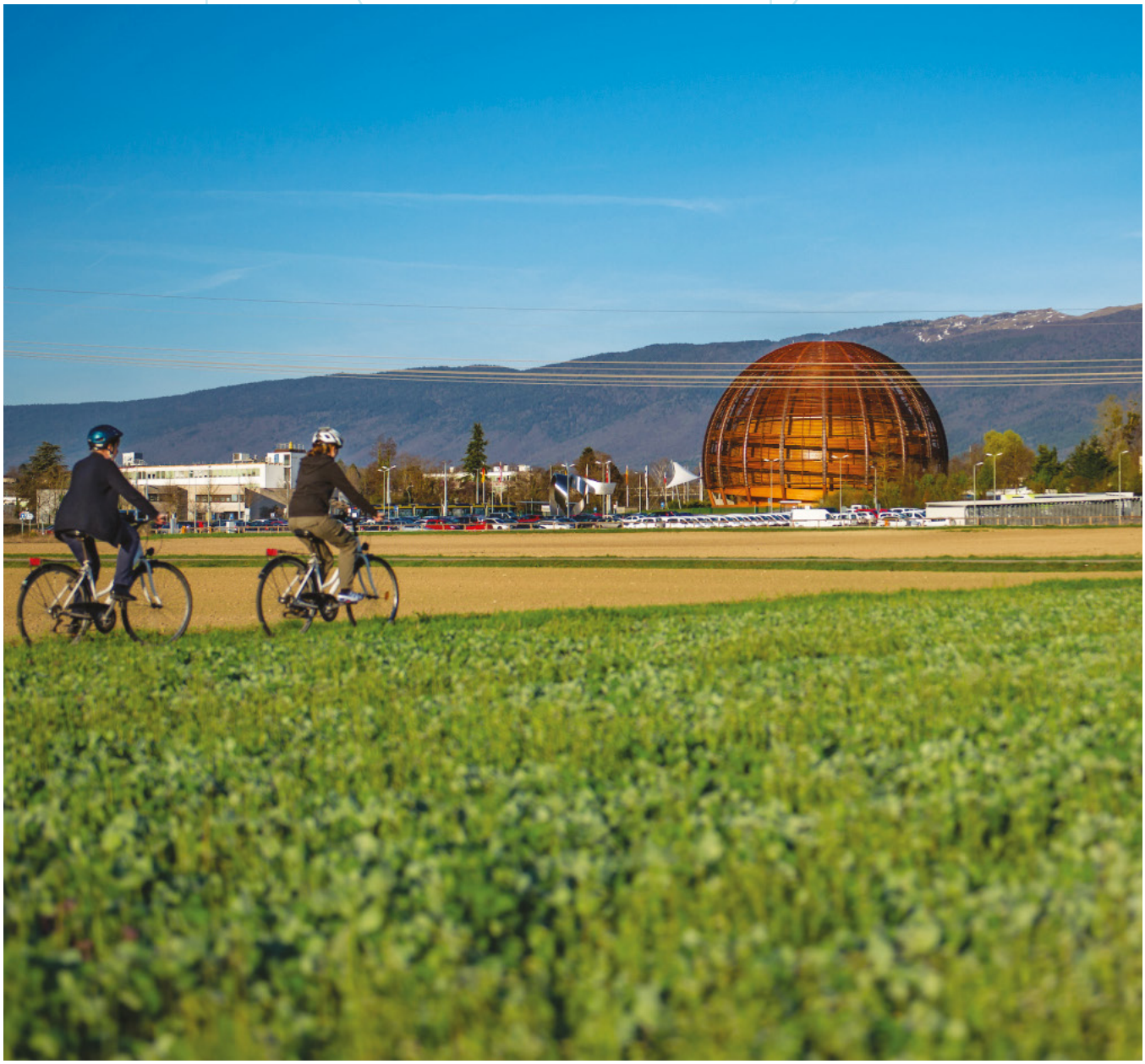
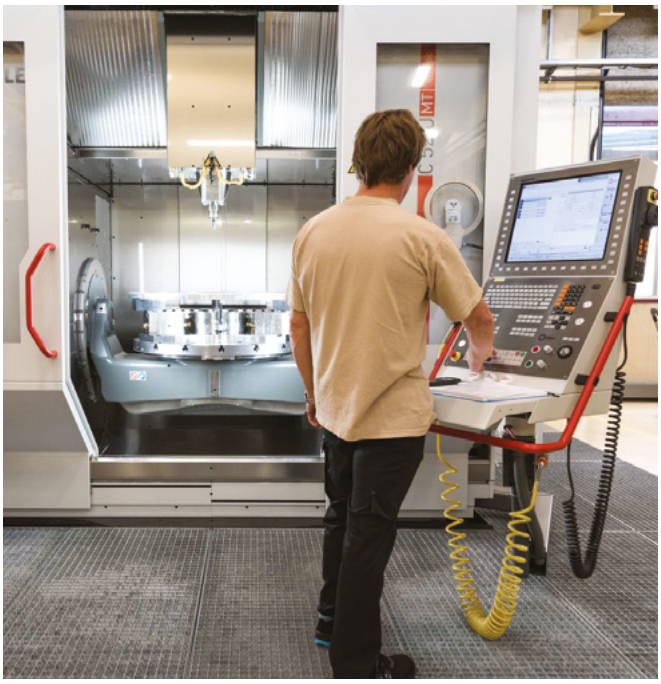
A SUSTAINABLE RESEARCH ENVIRONMENT

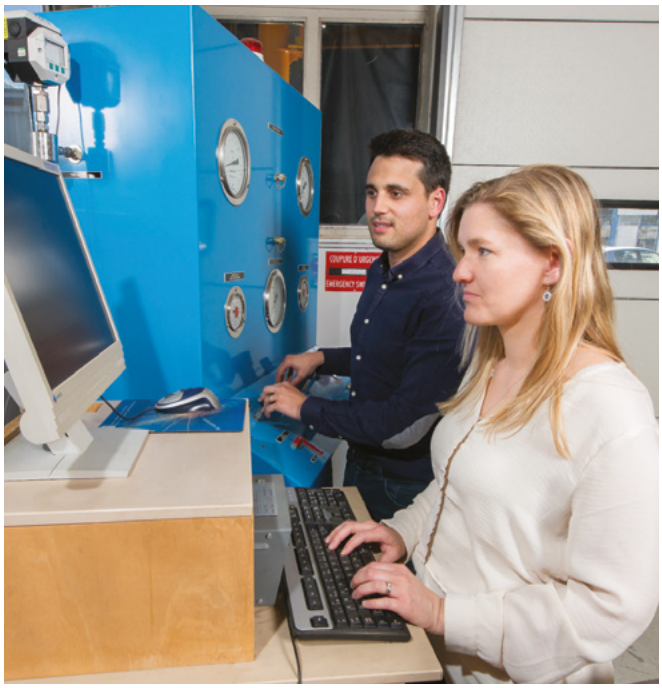
CERN is fully committed to ensuring the health and safety of everyone participating in the Organization's activities, present on the site or living in the vicinity of its installations. CERN works to limit the impact of its activities on the environment, and to guarantee best practice in matters of safety.

A view of the CERN main site with the Globe of Science and Innovation in the foreground. The Globe, conceived as a symbol of sustainable development, was reopened to the public in 2016 after a period of renovation. (OPEN-PHO-LIFE-2017-009-2)





Since the 2012 launch of a machine-tool compliance campaign, some 900 machines such as this one have been tested and declared compliant with CERN's safety rules. (CERN-PHOTO-201704-108-5)



Using the Kryolize software to test a pressure relief valve. (OPEN-PHO-SAFETY-2017-001-2)

A SOLID FOUNDATION FOR CERN RESEARCH

Highlights in the areas of health, safety and environmental protection (HSE) in 2016 include important progress towards HSE measures needed for the LHC's second long shutdown. World-leading research on cryogenic safety and detection systems for ionising radiation was carried out, and two new bodies were established: the CERN Environmental Protection Steering Board, which will oversee CERN's work to minimise its environmental impact, and a new working group charged with developing a mobility plan for CERN. Both will start work in 2017.

OCCUPATIONAL HEALTH AND SAFETY

CERN's future research programme is rich and varied, with a range of new projects getting under way. Making sure that each project achieves its goals while reaching the highest standards in health, safety and environmental protection is a top priority. Safety teams work closely with project personnel to balance each project's goals with those relating to HSE matters. In 2016, safety clearances were delivered to the NA61/SHINE and AWAKE experiments. Just as important as ensuring the safety of new projects is ensuring that established infrastructure conforms to the latest safety standards, and in 2016 the CERN Management gave the go-ahead for the SPS accelerator's fire safety consolidation project.

The LHC's second long shutdown begins at the end of 2018. Over a period of 24 months, a great deal of work will be carried out in CERN's surface and underground areas. Preparations for the safety of people and equipment are already well under way, with a review of the safety facilities needed ongoing and two dedicated safety training courses having been identified for development in the lead-up to the shutdown.

PIONEERING CRYOGENIC SAFETY

CERN hosted its first Cryogenic Safety Seminar in September. Attracting 120 participants from research institutions and companies around the world, the seminar was built around CERN's expert knowledge of cryogenics, particularly at the extremely low temperatures required by the LHC. The seminar covered topics including research and development, international standards for cryogenic safety, risk assessment, and the development of rules and regulations for cryogenic safety systems. One of the high points was the presentation of the Kryolize project, supported by CERN's Knowledge Transfer Fund (see p. 34), which is developing software for cryogenic safety systems effective from liquid helium temperatures to the relatively balmy realm of liquid nitrogen. Kryolize has many potential applications in research laboratories and industry. Seven academic and one commercial licence to use the software have already been granted.

Horses help to maintain CERN's forests

The CERN site covers 625 hectares, of which around 200 are fenced sites used for CERN's research activities. The rest of the land consists of fields rented out to farmers and about 90 hectares of forest, mainly in France and managed by the French forestry commission (*Office Nationale des Forêts*). Horses are involved in the removal of felled trees from some of CERN's woods in order to minimise the impact on the environment. (CERN-PHOTO-201703-074-12)

OCCUPATIONAL MEDICINE AND EMERGENCY PREPAREDNESS

The collaboration established in 2015 between CERN and the University Hospitals of Geneva (HUG) came into its own in 2016. Through this agreement, CERN hosts an emergency response unit on its Meyrin site. This provides a service not only for CERN's Swiss and French sites, but also for the surrounding region. This unit has helped to reduce emergency response times considerably for the area covered. In 2016, the team leapt into action some 60 times for on-site interventions.

The signing of a tripartite agreement between CERN and its Host States in December reinforced cross-border cooperation in the event of the need for emergency intervention on the CERN sites or in the surrounding areas. Such operations by Host State emergency services were previously governed by two agreements, one with the local authorities in Geneva and one with the French department of the Ain. The three partners are developing joint procedures and training exercises, and CERN's Fire and Rescue service benefits from the experience of the services in France and Switzerland.

RADIATION PROTECTION

CERN's excellent track record in radiation protection continued in 2016. Of 8909 monitored workers, only eight received an individual dose above 1 millisievert (mSv), and all were below 2 mSv. By comparison, the average dose received from natural sources and medical procedures by citizens in CERN's Member States ranges from around 3 to 4 mSv per year.

CERN's strong performance in radiation protection is the result of constant vigilance to remain in the vanguard of the field. In 2016, the Laboratory's Radiation Monitoring System for the Environment and Safety, RAMSES, which provides continuous state-of-the-art monitoring both inside and outside CERN's perimeter, was extended to cover a range of facilities. Refurbished facilities newly equipped with RAMSES include the PS East Hall and facilities in the SPS's North Experimental Area. Among the new facilities to be equipped with RAMSES are AWAKE, MEDICIS and the GBAR experiment.

Ten prototypes for the next generation of RAMSES electronics were readied for tests in 2016. Designed to provide high-performance, cost-effective and low-maintenance monitors for CERN, these will be installed during the second long shutdown and deployed from LHC Run 3, starting in 2021.

Following agreements with CERN's Host States, the Organization's radioactive waste treatment centre ramped up operations in 2016, safely eliminating some 1200 cubic metres of low-level radioactive waste, considerably more than the 310 cubic metres produced during the year. The safe elimination of radioactive waste is set to reach another milestone in 2017 following a detailed preparatory study for the disposal of the superconducting accelerating modules from CERN's former flagship accelerator, LEP, which concluded operations in 2000. CERN's proposed disposal method received approval from the Swiss authorities.

An important milestone towards future particle physics research with an optimised ecological footprint was achieved with the release of the ActiWiz3 computer programme. ActiWiz3 helps researchers to identify materials that result in a minimal dose for personnel and the lowest amount of radioactive waste for any accelerator or experimental environment. The programme became one of the standard tools for the characterisation and clearance of radioactive waste and equipment at CERN. Moreover, its use contributed to a new material clearance standard released by the US Department of Energy in 2016. Ten ActiWiz licences have been granted.

Safety training

43 866 e-learning safety courses followed
789 classroom safety courses delivered to **6 320** people
6 new or refurbished e-learning safety courses produced

Environmental protection

136 environmental monitoring stations keeping track of radiation, air and water quality
13 new hydrocarbon detectors monitoring CERN's waste water network

Radiation protection and general safety

1 200 cubic metres of low-level radioactive waste safely eliminated
18 licences granted for use of CERN-developed safety software packages
Over **500** bicycles available for personnel to travel around CERN sites

TRAINING FOR SAFETY

The overhaul of CERN's e-learning safety courses continued apace in 2016. A new modular approach launched in 2015 allows efficient delivery of courses tailored to individual needs, while also making it easier for developers to keep courses up to date. In 2016, six new or refurbished e-learning modules were released, 43 866 e-learning courses were followed, and 6320 people attended 789 classroom sessions delivered throughout the year.

ENVIRONMENTAL PROTECTION

CERN's environmental monitoring network was consolidated in 2016 with the installation of three new monitoring stations. This brings to 136 the total number of stations continually monitoring radiation, air and water quality, while also gathering meteorological data through a total of 539 measurement channels. In addition, a further 13 hydrocarbon detectors reinforced CERN's effluent water monitoring system, allowing early detection of hydrocarbon pollutants and thereby ensuring the rapid intervention of CERN's emergency services if necessary.

In 2016, CERN finalised a detailed assessment of prevention measures against water and soil pollution in areas where liquid chemical agents are used. The methodology and tools for a CERN-wide survey and risk analysis were put in place.

MOBILITY MANAGED

Transport is a major issue for CERN, encompassing daily commutes as well as travel between and around the CERN sites for the Laboratory's large number of visiting scientists. CERN has always favoured green solutions: while CERN cars are available for visitors to rent, bicycles are provided at no cost. In addition, a new 2.4-kilometre cycle path was inaugurated in October. It allows cyclists in the local area to travel safely and easily between CERN's two main sites. It has been financed by CERN and French local authorities.

With a view to improving safety and promoting green transport solutions at CERN, the role of the CERN Mobility Coordinator was created in 2016. Working with a lab-wide working group, the Mobility Coordinator will develop a mobility plan for CERN and will work with local groups to promote green initiatives such as Switzerland's Bike2Work challenge and the French *Challenge Mobilité*, while also improving safety for all road users.

BUILDING A GREENER FUTURE

After a period of renovation, CERN's Globe of Science and Innovation reopened to the public in 2016. Conceived as a symbol of sustainable development, the Globe was just one building among many that underwent refurbishment on the CERN sites through the year.

At work in one of CERN's environmental monitoring stations. (CERN-PHOTO-201603-064-1)