

A space research facility on ISS is controlled from Trondheim

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In the presence of the Minister of Commerce, Odd Eriksen, the Norwegian User Support and Operations Centre (N-USOC) at Plantebiosenteret (located at The Norwegian University of Science and Technology (NTNU) in Trondheim, Norway) was opened on March 31, 2006.



The N-USOC control center at NTNU.

Photo: Bjørn Pedersen, N-USOC.

N-USOC has been appointed as the EMCS Facility Responsible Centre by ESA. The N-USOC is responsible for the implementation of the International Space Station (ISS) ground segment for the biological facility EMCS operations preparation, real-time data dissemination and provisions for instantaneous experiment command processing. N-USOC also offers scientific and technical support to scientists who have been selected for EMCS experiments.

The European Modular Cultivation System (EMCS), which will be launched by the space shuttle Discovery for the ISS in July 2006, provides a fully controlled system dedicated primarily to experiments using plants, but also insects, amphibians, cell and tissue cultures. The EMCS is an experiment facility for biological investigations under microgravity, which allow the cultivation, stimulation, and crew-assisted operations of biological experiments under well-controlled environments. Conditions such as temperature, atmospheric composition, water supply, illumination, observation and acceleration on centrifuges will be controlled.

Since the period where most of the NASA and ESA selected experiments were performed during the 10-15 days onboard the space shuttle, space biologists have awaited the finalisation of an automatic facility with a life support system suitable for long duration experiment periods. The EMCS represents such a facility, operating by remote control on a centrifuge rotor for experiments with plants and other organisms in microgravity. This would enable the scientist on the ground to study development and behaviour of organisms under microgravity and different accelerations in space, with also the possibility of a permanent onboard 1g-control.

A decentralised ground infrastructure approach has been selected based on existing and nationally funded USOCs under the overall management of ESA. The overall responsibility of the EMCS throughout the entire payload's operational phases: i.e. pre-flight activities, in-flight operations and post-flight activities, relies on the N-USOC. For experiment operations, N-USOC will provide users with a communication and data processing infrastructure that allows real-time data monitoring and control. A user may come from either a university or industry teams and perform an experiment in the EMCS, thereby utilizing the ground infrastructure provided by N-USOC. The user either works at the N-USOC site in Norway or from the user's home base, i.e. a research institute,

which is connected over Internet to the N-USOC. The users thereby have the possibility of real-time monitoring and control of the experiment. To operate the EMCS facility and the experiments therein, the N-USOC is supported by the EMCS' payload developer, which provides experiment support from their industry site (EADS, Friedrichshafen, Germany) or on the N-USOC site when required.

The link between N-USOC, ISS and sub-partners is via Huntsville Operations Support Center located at the Marshall Space Flight Center in the USA. From the ISS via Huntsville, data from the experiments performed are transferred to N-USOC and finally to the scientists. The N-USOC is also connected to the Mission Control Center in Houston which is responsible for the real-time command and control of the ISS overall. The N-USOC is continuously receiving information on the EMCS conditions (e.g. temperature, pressure, air composition etc.) and also for the entire ISS.



At right. A picture of the EMCS during the final tests at Kennedy Space Center. Picture courtesy: EADS, Friedrichshafen, Germany.

Is it possible to grow plants on ISS from seeds to seeds?

A plant experiment proposed by a scientific group at the Department of Physics and one at the Department of Biology (Plantebiosenteret) using the model plant *Arabidopsis thaliana* has been selected as the first Norwegian biological experiment on the ISS. The ultimate goal of the experiment – which has been subdivided into three parts – is to examine if dry seeds brought onto the ISS can be germinated in the EMCS and develop, during a 2-3 months period, new plants, which produce viable seeds.

When growing this model plant in the experiment containers (ECs) in the EMCS on the Earth, the germination and growth process goes smoothly and it takes less than 2 months to produce new seeds. Is it possible to obtain the same results under the weightlessness and cosmic radiation on the ISS – or will technical constraints in the fully automatic EMCS prevent the success of the experiment?

One of the first tasks for the N-USOC (Norwegian User Support and Operations Centre) located at Plantebiosenteret, NTNU, will be to support two scientific NTNU-groups in their specific plans for performing a complete life cycle study in the EMCS (European Modular Cultivation System). The preparative work for this experiment, which has been accepted by ESA and NASA, has been going on for a period of time. The experiment called MULTIGEN consists of three parts:

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