ASSESS-2 Germany's Early Participation in SpaceLab Preparatory Activities

"Thanks for the fine ASSESS-2 job - Juergen" wrote Stan Reinartz (ASSESS-2 simulation coordinator) on 27 May 1977 for Juergen Fein (see image, Fig 7 below), one of the two ESA selected Experiment Operators (E/O) or Payload Specialists (P/S) from DLR's German Space Operations Center (GSOC) located in Oberpfaffenhofen, Bavaria), who participated in the ASSESS-II program in May 1977, almost 40 years ago.

Fig.1 Convair CV-990

The ASSESS program (ASSESS 1 and 2) used the flying laboratory managed by the NASA/AMES Airborne Science Office. This laboratory was a modified Convair CV 990 commercial aircraft Fig. 1.
Of prime importance for the simulation was that **real experiments** were flown allowing authentic science to be conducted, and that the period during which the mission had to be conducted was critical to the investigators which resulted into a strict schedule to take-off.
This implied that the program was supported by motivated investigators who had to work under realistic time schedules as was the case for Spacelab. The use of standard racks, provisioning of resources and experiment support equipment permitted good simulation of the planned Spacelab operations.

ASSESS-1 Mission
The first ASSESS mission was conducted during **June 1975** and consisted of a 5 days flying period during which the payload crew was confined to the aircraft, thus simulating the nominal one week Spacelab orbital conditions. Following the constrained period, two additional weeks were devoted to unconstrained flights with experiment operation by the principal investigators themselves to complement the data obtained by the payload specialists and to permit comparison of payload specialist and investigator performance.

During Spacelab flights the orbiter cabin was used as living and sleeping quarters for the Spacelab crew. In ASSESS these conditions were simulated by the use of a "camper" which was brought to the level of the rear aircraft exit, as shown in Fig. 2, during the time the aircraft was on the ground. ASSESS-1 was a joint NASA/ESA mission, it involved only 1 ESA experiment and 2 ESA provided Experiment Operators (E/Os). [1]

◂ Fig. 2 Sleeping Quarters with attached "Camper"

ASSESS-2 Mission
The second ASSESS mission was conducted during **May 1977** and consisted of a 9 days flying period. After the successful first ASSESS mission ESA and NASA jointly decided to embark on a second mission with an expanded scope. The objectives of the second mission are summarized below.
As a consequence of the ASSESS-1 results ESA expanded its participation considerably: 5 ESA experiments and 4 ESA/DFVLR E/O (aka Payload Specialists - P/S).
In addition ESA decided on a pre-integration of the five experiments in Europe and a pre-simulation training of the selected ESA E/O in Europe in order to facilitate the joint integration and pre-training at NASA/AMES most efficiently.
It should be noted that not only flight hardware and its operation was to be addressed, but also complementary items such as: ground support equipment requirements, documentation, documentation control, and ground operational procedures. The overall objective was to fully exercise the organization planned for the First Spacelab Payload (FSLP) flight. [2]

Mission Goals

The project covered a period of approximately twelve months (May 1976 – May 1977) from initial approval to flight, and studied the full range of Spacelab-type activities including:

- Management interactions.
- Experiment selection.
- Hardware development.
- Payload integration and checkout.
- Mission Specialist (M/S) and Payload Specialist (P/S) selection and training.
- Mission Control Center/Payload Operations Control Center interactions with ground and flight problems.

- Real time interaction during flight between Principal Investigators (PIs) and the Mission Specialist/Payload Specialist flight crew.
- Retrieval of scientific data and analysis.

Mission Objectives

Science related

- Evaluate experiment selection procedures.
- Evaluate participation of PI in mission planning and implementation, and utilization of an Investigators' Working Group (IWG) chaired by a Mission Scientist.
- Maximize science data.

Management related

- Study proposed NASA and ESA/SPICE Spacelab payload management concepts and interface relationships.
- Evaluate Mission Manager, Mission Specialist, and Payload Specialist roles in mission planning and implementation.

Analytical Engineering and Mission Planning

- Evaluate the methods and effectiveness of performing analytical system engineering, mission flight interface definition, and interface control.

Payload Specialist Selection and Training

- Evaluate methodology of Payload Specialist selection and training
- Determine practicability of a PI as a Payload Specialist

Conduct of the Flight Mission

For ASSESS-2 nine aircraft flights (data-take periods) in nine successive days were planned to represent a single Spacelab mission. The NASA flight crew consisted of one Mission Specialist (M/S) and four P/S (two from NASA and ESA each) were to be fully confined to the aircraft and living quarters throughout the entire period. [2,3].

ASSESS-2 Analysis from the European (ESA/DFVLR) Perspective

Because of the expanded goals for ASSESS-2 ESA together with DFVLR (in 1997 renamed to German Aerospace Center – DLR) embarked on very expansive preparatory activities. A real scale mockup of the CV-990 fuselage together with attached confined living quarters (Fig. 3,4) was built up at the DFVLR Institute for Space Simulation at its premises in Cologne-Porz/Wahn for experiment pre-integration and realistic simulations. Attached was a Payload Operations Control Center (POCC, Fig. 5) for coordination with the crew during confined mission sessions and a visitor room for following the activities via TV monitors.

The finally selected two ESA payload specialists (C. Nicollier, M. Tayler) and the two DFVLR payload specialists (K. Kramp, J. Fein) were evaluated by the DFVLR Institute for Flight Medicine at its

psychological section in Hamburg and after that the medical suitability was tested according to airline pilot regulations at the Lufthansa Pilot Training Center in Hamburg.

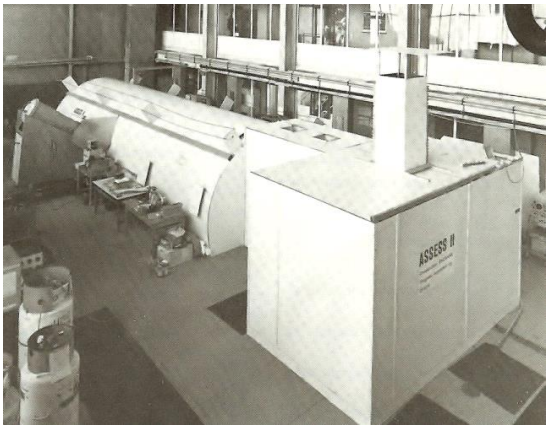

Fig. 3 Convair Mock-up at DFLR, Cologne

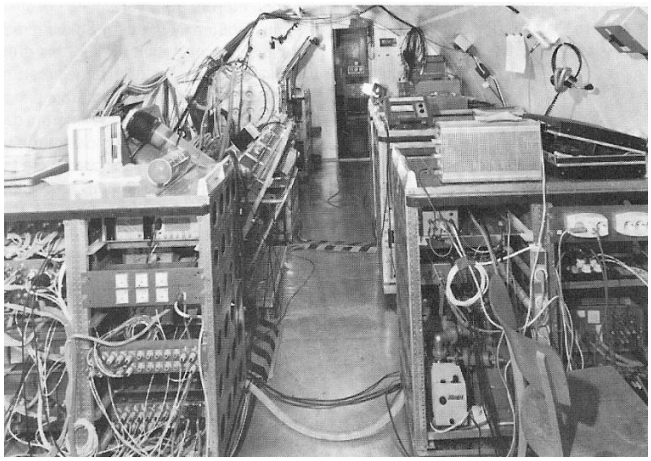

Fig. 4 Integrated European Racks inside the Mock-up

Fig. 5 Payload Operations Control Center (POCC) at DFVLR (now DLR)

After the psychological and medical confirmation of the candidates the experiment training began. It turned out that the following approach – necessitated by time constraints and PI's availability problems – yielded the best results and would be applied for the real Spacelab flights as well: the P/S training started with travelling to the experimenter's laboratories receiving documentation, lectures and exposure to the experiments (some still not finished yet). After that the PI's should have shouldered the pre-integration and check out in Cologne. However, it turned out that most of the work had to be carried out by the P/S being beneficial for the P/S to gain deep insights in the experiments but introducing long working hours. The other unplanned aspect was – as it quickly turned out when experiment checkout started – that there was a lack of operating procedures for the experiments. Thus, the P/S had to fill the gap in addition to their training tasks.

After the integration of the European experiments into the Convair mock-up at Cologne Porz/Wahn two 4-day long "confined" mission simulation sessions with the NASA Mission Specialist (M/S) K. Henize were conducted to find out whether the planned experiment "timelines" could be executed during the allotted time slots. That turned out to be very beneficial for the following joint training sessions with the NASA P/S at AMES. The European mission simulation concluded the European pre-integration, the experiments were dismantled and shipped to AMES.

At AMES the integration and testing of the European experiments again was handled primarily by the P/S since most of the experimenters had availability problems. After proper installation into the Convair

another non-flying joint mission simulation with the NASA P/S took place for crew familiarization and integration.
The actual flying mission took place as planned on 9 consecutive days with nine aircraft flights (data-take periods), totaling 53 flight hours. The mission specialist (NASA) and four payload specialists (2 from NASA, ESA each) were fully confined to the aircraft and living quarters throughout the entire period (Fig 6). Pre-established timelines for P/S training and operation of experiments were used as baselines for pre-data~take periods and data-taking operations of the payload.

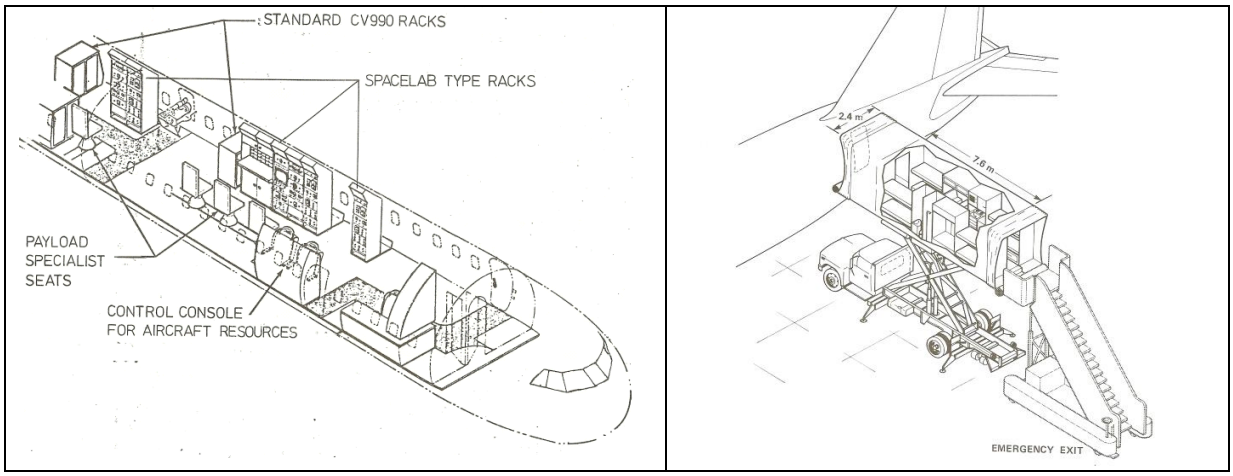

Fig. 6 Artist's impression of CV-990 interior layout (left) and attached Crew living Quarters

Daily briefings and debriefings were conducted before and after data-take periods from the Mission Control Center (MCC) at AMES for flight operations and from the POCC for payload operations. As the flight proceeded, payload problems and flight conditions necessitated real time changes from the preplanned experiment objectives tracks and changes of plans for given experiment observation periods. Communication was possible with the payload crew during data-take as well as the ground based periods. Communication was generally poor or impossible over the HF radio system during aircraft flights. The M/S coordinated communications to and from the payload crew. Communication blackout periods were scheduled into the overall timeline to represent Spacelab communications blackout periods as well. Generally most experiments produced good data, but many real-time problems occurred and were addressed by onboard and ground based personnel, which resulted in varying degrees of correction and several alterations of flight plans.
It should also be noted that ESA originally planned to appoint two as prime P/S and two as backup P/S. In reality, ESA decided, with NASA Program Manager's concurrence, to change one of the P/Ss during the mission flight period so that three of the ESA P/S participated as payload flight members. Of course the remaining fourth ESA P/S was fully occupied with his role as payload coordinator at the POCC – bridging the gap between the "flying" P/S and the PIs for trouble shooting and re-planning activities. [3, 4]

Conclusions

The following results and contributions transpired from the European perspective and mostly were respected for the following real Spacelab flights (FSLP, D-1, D-2).

- European checkout and pre-integration of the European payload is mandatory.
- Involvement of P/S in experiment checkout, testing, integration (preferably starting during the experiment design phase already) and operational procedure generation is extremely beneficial.
- Realistic European "stand-alone" mission simulation saves a lot of time during flight preparation at NASA.

Fig. 7 European ASSESS Payload Specialists (from left): Claude Nicollier, Klaus Kramp, Mike Tayler, Juergen Fein [4]

Benefits from DFVLR's Point of View

- The know-how collected during European P/S selection, payload integration, simulation and payload operations under simulated conditions (including operations procedures generation) made DFVLR at Cologne Porz/Wahn with its existing expertise in flight medicine the destined institution in Europe for Astronaut selection, training and coaching. In fact, ESA established the ESA Astronaut Training Center (EAC) as joint center at on the premises of DLR in Porz/Wahn in 1990.

- The idea of establishing a POCC for European mission simulation purposes at DFVLR led to the idea of establishing a provisional "remote POCC" at DLR's GSOC at Oberpfaffenhofen during the FSLP flight (Ulf Merbold) and came to full fruition during the D-1 and D-2 spacelab missions when all the European PIs could be accommodated at the new "Manned Spacelaboratories Control Center" (MSCC) at Oberpfaffenhofen, saving a lot of travelling money for the European PIs.

SpaceOps News Interview with Jürgen Fein (ASSESS-2 Participant)
SpaceOps News (**SoN**) recently had the opportunity to talk to **Juergen Fein**, one of the DLR P/S of ASSESS-2 participants about his experience in retrospective.

SoN: According to ref [1] ESA participated already in the ASSESS-1 program by providing one European experiment and one Experiment Operator (E/O). Did you as ASSESS-2 participants have some experience exchange with him on his role as ASSESS-1 E/O and why was he not participating in ASSES-2?

Juergen Fein: The only exchange of experience we got, was a report and a documentary movie of the ASSESS-1 mission during our kickoff-meeting in Porz-Wahn on Sep. 27, 1976. The presentation was held by Dr. Beckman from ESTEC, who was the appointed ESA E/O during the ASSESS-1 mission and co-investigator during the ASSESS-2 mission. Some little experience was also provided by our colleague Mike Tayler, who participated in the ASSESS-1 mission as experiment operator of the airglow experiment of the University of Southampton.

SoN: Only Claude Nicollier made it into the “real” astronaut team but never flying on a Spacelab mission. He later became a mission specialist (M/S) and flew on four STS missions (STS-46, STS-61, STS-75 und STS-103). What were the constraints for the ASSESS-II participants to join the astronaut ranks?

Juergen Fein: The pre-conditions for the ASSESS-2 participants to join the European Astronaut Team were simply to go through the complete selection process again. This process of course was based on the one used for ASSESS-2 but revised with all the findings we experienced during ASSESS-2.

SoN: The ASSESS-2 preparatory program was instrumental for the success of the Spacelab flights. Would you remember any items you encountered which absolutely had to be avoided during the real flights? Where important “flight”- issues like food, leisure time and family contact addressed during the ASSESS-II mission?

Juergen Fein: I cannot remember any item that had to be avoided during S/L-flights, except the circumstance that during the ASSESS-2 flights we had very poor communication coverages between the aircraft and the POCC (Payload Operations Control Center). This made operations support from the POCC almost impossible, in total contrast to the S/L missions.
'Flight issues' like food and leisure time were of course addressed during the ASSESS-2 mission. During our training period in Europe family contact was always possible between the training sessions at the different experiment locations. During our stay at NASA/Ames in USA my family could travel with me and was living at Palo Alto, close by.

SoN: What was the most important result according to your judgement?

Juergen Fein: It's hard to say and I think there is no 'most important result'. I think it was the sum of experiences I got, which helped me a lot during my Spacelab I (FSLP) assignment for mission preparations and later as POCC flight controller. It was of utmost importance for a successful mission to have been able to establish close contact with the scientists of those experiments I was responsible for as well with the payload specialists, which made procedure development, operations planning and operations/conversation between onboard and ground during the mission very efficient.

Thank you for your open and frank answers and going through the trouble of recalling your experiences in the early days of human spaceflight.

References

[1] NASA/ESA CV-990 Spacelab Simulation (Final Report) by John O. Reller, Jr, January 1976

[2] XXV Raumfahrt Kongress by J. de Waard, Hermann Oberth Gesellschaft e.V., Bremen, 9-12 Sept. 1976

[3] NASA/ESA CV-990 Spacelab Simulation ASSESS II (Final Report), by B.T. Nolan, NASA-OA, W.O. Armstrong, NASA-OSF, J. de Waard ESA-SPICE) [4] Mitarbeit am Spacelab-Vorprogramm ASSESS II (P. Kleber et al.) DFVLR Nachrichten , 1977 (?)

[4] NASA Image AC 27-0393-226 (27 May 1977)

July 2016, Joachim J. Kehr, Editor SpaceOps News for the „Journal of SpaceOperations & Communicator“