

## China's Space Station Operations Concept

The Beijing Aerospace Control Centre (BACC) is responsible for China's human spaceflight and planetary exploration programs (Fig.2). The BACC is located inside the Haidian district nicknamed Beijing "Aerospace City", in the northwest of Beijing about 14 km from the city center (Fig 1). The construction of the center began in 1994 in order to support the Project 921, the human spaceflight program. The BACC became operational in 1998.



*Fig 1 Google Earth map Beijing: BACC and Aerospace Campus, marked in the center[Google Earth]*



*Fig 2 Beijing Aerospace Control Center (BACC)*



*Fig.3 BACC Space Station Control Room [3]*

The BACC has supported all of China's Shenzhou flight missions and Chang'e lunar probing missions.

BACC's main responsibility is the long-term management of China's space station program, which included the operations of the now de-commissioned Tiangong 1 and 2 space laboratories, and it was responsible for operations of the China Space Station (CSS) from the launch of the Tianhe 1 core module throughout the completion of the CSS in 2023.

The BACC now is responsible for CSS' long-term maintenance and operations.

The tasks of the BACC control center includes sending command packages to the space station hardware and to approaching, docked or departing vehicles for resupply and crew transport, and issues instructions to the astronauts for routine, maintenance and emergency operations. It collects, stores, processes and analyzes telemetry information from the other support centers.

It also receives information from launch centers, tracking stations and tracking ships around the globe in real-time via a communications network consisting of communications satellites, fiber-optic, and UHF. The Chinese geostationary satellite relay system Tian Lian just recently got augmented by a third Tian Lian 2 (03) satellite providing consecutive 30 min coverage for the China space station communications (July 2022) during each orbit. [2]

The central command & control room of the BACC is equipped with large projector screens and multiple control consoles, as well as a visitor area for VIP guests and press. (Fig.3)

In a typical crewed Shenzhou mission, the Mission Command and Control Centre (MCCC) of the Jiuquan Satellite Launch Centre (JSLC), located in the Gobi Desert, Inner Mongolia, is responsible for monitoring and managing the spacecraft during the launch and ascending stage of the flight. Once the spacecraft is inserted into its initial orbit, BACC takes over the control of the spacecraft and remains in charge throughout the mission until the crewed re-entry capsule has landed.

The Beijing "Aerospace City" is a research and development hub, astronaut training base and mission control center for China's human space flight, space exploration and satellite projects. The facilities are located on large campus situated on a 2.3 square kilometers (577 acres) in the Haidian district (Fig.1).

First becoming operational in 1998, it is the home of the Beijing Aerospace Control Centre (BACC), the China Academy of Space Technology (CAST), and the Astronaut Centre of China (ACC) providing all necessary facilities like a full-size Shenzhou training mock-up, vacuum chambers, human centrifuge, a neutral buoyancy water tank for simulated extra-vehicular activity (EVA) training, astronaut dormitory and a gym. Astronauts complete the majority of their training program in the center.

The China Academy of Space Technology (CAST) also provides a range of support facilities including accommodations, offices and a conference center and a whole range of spacecraft development and test facilities to support the entire spacecraft design and development process is provided. They include spacecraft assembly, integration and test (AIT) facilities, wind tunnels and thermal vacuum chambers (TVC).

All Shenzhou crewed vehicles and Tiangong experimental orbital stations were assembled and tested here. [1]

Overall, the BACC is the critical facility for China's space program, providing essential support for crewed and robotic space missions.

It can be stated that the centralized BACC control center approach, i.e., to have management, programmatic, design and development, astronaut training, communications, and operations collocated at one place has great advantages over a decentralized approach as used in the USA or Europe, thus allowing program planning and project execution in the most efficient way.

Having some experience with ISS and MIR space station operations, the editor would have liked to find more details about the CSS mission operations concept, however no more detailed information could be found on the internet. Therefore I discuss some of the questions below.

Maybe one of our associated China SpaceOps friends will be able to provide more details. Don't

hesitate to share them with me. I would update the article accordingly and share it with the SpaceOps community. [3]

#### 1. Manpower and Task allocation

If one looks at the control room image above (Fig. 3) the extreme number of control room consoles and engineers is surprising.

Do they only have one big ‘main’ control room, dedicated to the current project or are more ‘main’ control rooms available?

Are they using “back-rooms” and other support rooms?

Are subsystem controllers dedicated to one project or are they shared between projects if need arises?

What is the degree of automation (AI expert systems) for mission operations and ground control teams?

#### 2. Hardware Manufacturer support

Is the industrial manufacturers expert-support provided at the BACC directly or remotely in real-time in case of system anomalies?

#### 3. Science Data evaluation

Are the scientific raw data distributed or shared in real-time to remote scientific institutes or are the data stored and preprocessed at the BACC?

Can selected scientists be accommodated at the BACC for experiment real-time control?

#### 4. Mission Planning

Degree of automation for the on-board resource distribution and optimization process?

The degree of astronaut on-board autonomy has to be factored in – does the schedule allow some leeway for on-board decisions?

How fast is the turn-around time for re-scheduling?

How many engineers are dedicated to the mission planning team?

#### 5. Crew Interface

Who is allowed to talk to the crew and how is the privacy of astronaut discussions secured?

#### 6. Interface with other Crewed Spaceflight Agencies

Was it considered during the design and construction of the CSS to take any flight hardware, communications or procedural compatibility or standardization considerations with other Agencies like NASA, ROSCOSMOS, JAXA, ESA, CSA or ISRO into account?

#### References

[1] <https://chinaspacereport.wordpress.com/facilities/beijing/>

[2] <https://www.space.com/china-launches-communications-satellite-tiangong-space-station>

[3] Editor Journal of SpaceOperations & Communicator, e-mail [joachimkehr@aol.com](mailto:joachimkehr@aol.com)

[Further Info] BACC youtube video 2023:

<https://www.google.com/search?q=Beijing+Aerospace+Control+Centre&oq=Beijing+Aerospace+Control+Centre&aqs=chrome.69i59j0i22i30j0i15i22i30j0i390i650l2j69i60l3.1214j0j7&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:de83255f,vid:kCtmMVyRbOs>