The end of the Cold War

Project ASTP

APOLLO – SOYUZ / SOYUZ - APOLLO

Carlos González

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This essay, as all the previous, is dedicated to my wife, Estrella, and daughters, Raquel and Sara, who have seldom seen me in the last months while I was busy with compiling all the available information existing on the subject and mixing it with my own memories.

Carlos González

Mission patch as worn by the Americans
APOLLO - SOYUZ

Mission patch as worn by the Soviets
SOYUZ - APOLLO

Brief history of Program ASTP

(Carlos Gonzalez. Ex Operations MGR at MDSCC)

Foreword

This is July 1975.

During 30 years, the two most powerful economic and military Nations in the world had had such big disagreements that it had actually become a state of "Cold War" and it had finally come the time to stop this nonsense which had been threading the survival of our home, Earth.

The President of the USA, Richard Nixon, and Soviet´s Prime Minister, Alexei Kosygin, meet in Moscow in the 24th of May 1972 and signed and agreement of cooperation by which they would help each other in the case of an accident of a space ship much as it happens in the oceans when a ship, from any nationality, sends an SOS.

Almost nine years before, the then President of the USA, late John F. Kennedy, already offered the USSR the possibility of trying a joint Project for a trip to the Moon but it seems that his counterpart, Soviet Premier, Nikita Khrushchev, did not take the offer into account.

And, thereby, the Damocles sword, which was hanging over the humanity's head for such a long time, was holstered.

1. BEGINNINGS

We are in Moscow and it is 24th of May 1972, the USA President at the time, Richard Nixon, and Soviet´s Prime Minister, Alexei Kosygin, signed an ACCEUOSPP (Agreement Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes) by which an astronaut or a cosmonaut would receive help from each other in case of necessity as it happens in the seas when a ship, from whatever nationality, sends an SOS.

Fig. 1.1 Launch of Apollo XVIII

Fig. 1.2 Launch of SOYUZ 19

Both space agencies were immediately in favor of this cooperation and a program of technological interchange was designed, established and set into operation.

This program ended up in the Apollo – Soyuz Test Project, ASTP.

The negotiations were not simple. The US had a unique interlocutor, NASA, while the USSR had the responsibilities of the space exploration divided into four stratums which would normally compete against each other.

The directors of each were: Sergei Korolev, Mikhail Yangel, Valentin Glushko, and Vladimir Chelomei. Out of all of them, Korolev was the Chief designer, though this didn´t mean he was the boss. Moreover, due to the extreme secrecy of anything pertaining to space exploration, neither of them normally knew the whereabouts of the others.

Fig. 1.3 Soviet and American engineers verify the operation of the Apollo-Soyuz attachment system.

The first thing in the technological interchange program was to create a schedule of mutual visits among astronauts and cosmonauts aiming to a good mutual training.

We should remember, here, the address before the 18th General Assembly of the UN back in September 20th, 1963, by late President of the US, John F. Kennedy, <…*Space offers no problems of sovereignty…Why, therefore, should man´s first flight to the Moon be a matter of national competition?...*> <*...Why should the United States and the Soviet Union, in preparing for such expeditions, become involved in massive duplications of research, construction and expenditure……*>

Soviet´s Prime Minister, Nikita Khrushchev, did not respond to the invitation and the possibility of a joint USA-USSR project died before being born. Did Khrushchev want to maintain the secrets of his advantages in space exploration and the development of ballistic missiles? Did the initiative die with the assassination of President Kennedy two months later, November 22nd, 1963?.....

2. THE ACTORS

Prime crew for Apollo

Position	Astronaut	
Commander	Thomas P. Stafford Fourth and last flight	
Command Module Pilot	Vance D. Brand First flight	
Ensemble Module Pilot	Donald K. Slayton Only flight	

Backup crew for Apollo

Position	Astronaut	
Commander	Alan L. Bean	
Command Module Pilot	Ronald E. Evans	
Ensemble Module Pilot	Jack R. Lousma	

Prime crew for Soyuz

Position	Cosmonaut	
Commander	Alexey Leonov Second and last flight	
Flight engineer	Valeri Kubasov Second flight	

Backup crew for Soyuz

Position	Cosmonaut	
Commander	Anatoly Filipchenko	
Flight engineer	Nikolay Rukavishnikov	

Final combined crew

Standing from left to right:
Stafford y Leonov

Sitting from left to right:
Slayton, Brand y Kubasov

3. SPECIALIZED TRAINING

The selected crews for this Project had to immerse themselves into the Technology and the language of each other to be able to understand the philosophy and the way the equipment of their counterparts worked and to be able to communicate among them.

Fig. 3.1

There was also the need to adapt the differences between both vehicles like capsule´s pressure and atmospheric composition. The Soviet´s Soyuz had a cabin pressure of 520 mm of Hg (reduced by 240 mm of Hg from the normal for this mission) and an atmosphere composed of oxygen and nitrogen while the American´s Apollo had a cabin pressure of 260 mm of Hg and an atmosphere of pure oxygen.

And so, there was the need to design and fabricate an ensemble module that would be able to attach to both vehicles and serve as a hermetic compartment to equalize pressures, mix the different atmospheres and, also, fit the different type of hatches, diameters and locks.

The module was designed in a conjoint effort by USSR and USA and it was fabricated in the USA. It was a cylinder 3 m long and 1.5 m in diameter that permitted that any of the ships could be active or passive during the rendezvous operations. It could also be liberated and ejected in case of problems. The principal designer was Bill Creasy.

Fig. 3.2 Lunch during a training session in a Command Module in NASA

But not everything was as easy as it was thought. USSR built their space vehicles with an as automatic operation as possible, leaving very few options for manual operations by the cosmonauts. Thus, they drastically reduced the high degree of training and spacecraft knowledge needed and minimized the possibility of human error. USSR frequently accused USA of

designing and building space vehicles <*...extremely complex and dangerous...*>

Americans, on the other side, criticized the absence of redundancy of equipment and instruments of Soviet´s crafts where each component was designed and dedicated to a single function and a failure of any of them would mean the mission would have to be aborted and they would have to return home.

TV transmissions also had their own problems. Soviet´s had less resolution and features of American´s. So NASA accepted the responsibility of making sure TV transmissions were received on the ground with appropriate quality.

Communications had nothing in common as well. Telemetry, command, audio and navigation systems were totally different and thus, astronauts, cosmonauts, and a large group of engineers and specialists from both Nations travelled back and forth to get familiarized with them.

Fig. 3.3 Another phase of the training

And there were other problems like the differences in standards: meters vice yards, liters vice gallons, grams vice pounds, etc. But this was only the basic, there were obviously other things: pressure, temperature, work, force, speed, acceleration, thrust, etc.

Soviet cosmonauts and ground controllers travelled to the US and received Apollo capsule training at the Johnson Space Center while American astronauts and controllers went to the USSR to receive Soyuz capsule training at the City of Stars in Moscow. Obviously, there were joint training sessions in both places.

Cosmonauts paid the first visit to JSC in July, 1973, followed by astronauts´ visit to Moscow in November. By the end of April and beginning of May, 1974, Soviets went back to the US while Americans went to Moscow in June and July. The third trip for the Soviets was in September of that same year and the fourth and last in February, 1975, Americans, in the mean while, traveled to Moscow during the end of April and beginning of May of that year being the first Americans to visit the Tyuratam launch complex on April 28th.

Three joint simulations were conducted, including the flight crews and ground controllers, between Control Centers at Houston and Moscow on 13th, 15th and 18th of May 1975, to check communications. These simulations were categorized as dress rehearsals.

The last dress rehearsal took place from June 30th to July 1st 1975, and it included all technical and operations personnel from both Countries.

Additionally, in December 1974, Soviets launched a manned mission with a modified version of the Soyuz vehicle to complete the final acceptance tests and system operability functions (Soyuz 16).

But the most difficult problem to cope with, by far, was the language. First, they all tried to speak in English, then in Russian, then each in their own languages and nothing worked satisfactorily until they decided that they would use their counterparts language and that solved the problem.

Fig. 3.4 Training at JSC using a replica of a Soyuz capsule

Due to the slowness and slurring of the way Sttaford spoke Russian, Leonov as a joke said <*...Inside the capsules three languages were spoken, Russian, English and Oklahomeski...*>

Remembering the words of Soviet commander, ***Alexey Leonov***, <*...just trying will make it worth...*>

4. TRACKING AND CONTROL

NASA and the Soviet Academy of Science agreed that the Fresnedillas Tracking Station in Madrid would be the primary ground communications centre. To this effect, a mini Station with two antennas and equipped for the tracking and control of the geosynchronous satellite ATS-6 was installed within the grounds of Fresnedillas. This satellite was located at an altitude of 32,000 km over the vertical of Kenya.

Fig. 4.1 ATS-6 antennas at Fresnedillas

With these new antennas, the view period of the Station was extended to 60% of the total. In other words, out of the 87 minutes of each revolution around the planet, 52 were in view of Madrid.

The rest of the NASA network was composed of 14 ground stations around the world, the tracking ship USNS *Vanguard* and three ARIA aircraft with UHF and VHF antennas. Practically, the Apollo-Soyuz was in view constantly.

Fig. 4.2 USNS Vanguard

The USSR contributed with seven ground stations and the tracking ships *Sergei Korolev* and *Yuri Gagarin*.

Fig. 4.3 Tracking ship Sergei Korolev

In the beginning of 1975, INTA-NASA made a selection of a group of engineers and technicians from Fresnedillas to receive a training course on the peculiarities of this mission.

This course paid especial attention to the Soyuz vehicle and the differences of its communications and navigation systems.

The course took place at the USA Embassy in Madrid and the final success of the joint mission proved that it had been a great idea.

Fig.4.4 ARIA aircraft

5. BREAKING THE ICE. SPACE HUG

On July 15th, 1975, a Soyuz launcher carrying a Soyuz 7K-TM capsule (Soyuz 19) that had been modified for this mission, and a Saturn IB carrying the Apollo XVIII with a command module (CM) capsule that had also been modified for this mission, were launched from the Baikonur Complex, Kazakhstan, USSR, and the Kennedy Space Center, Florida, USA, at 12:20 and 19:50 GMT respectably. The Apollo ship carried also the androgynous attachment module designed by Bill Creasy.

Fig. 5.1 Launches of the Apollo XVIII and the Soyuz 19 crafts

The Soyuz ship attained a small elliptical orbit with an apogee of 221.9 km, a perigee of 186.3 km, an orbit period of 88.5 min and an inclination of 51.8°.

For the first time, the launch was televised, in real time and color, to the USSR, the USA and East and West Europe. Authorized foreigner journalists witnessed this event live from a press room in Moscow.

US President Gerald Ford, Soviet´s Ambassador Anatoly P. Dobrynin and NASA Administrator James C. Fletcher watched the event in the US Department of State before the last two flew to the Kennedy Space Center to watch the launch of the Apollo craft live.

During the Soyuz´s third orbit, cosmonauts established contact with Houston Control Center initiating, by this action, the global communications system designed for this mission.

During the fifth orbit, cosmonauts adjusted the ship´s trajectory so they could meet with the Apollo. Their parameters were: 231.7 km of apogee and 192.4 km of perigee.

Apollo´s launch, seven and a half hours after Soyuz´s, placed the ship into an almost circular orbit of 173.3 km of apogee, 154.7 km of perigee, 87.6 min of period, and an inclination of 51.8°.

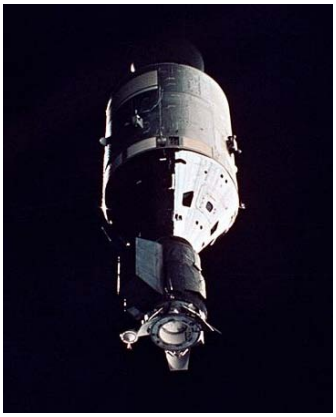

Fig. 5.2 CSM attached to the ensemble module

One hour and thirty four minutes after liftoff, the CSM turned 180°, latched to the Soyuz ensemble module inside the third stage and pulled it off. This maneuver was recorded and retransmitted back to ground through ATS-6.

A trajectory change, two hours later, placed the Apollo in a 172 km circular orbit while the Soyuz also performed a trajectory change, a little more than an hour later, to attain a 229 km circular orbit.

A few more of these maneuvers and a final braking at 14:51 GMT placed the Apollo into a 229.4 km circular orbit and, just a few minutes later, Brand announced <...*We have the Soyuz in the sextant...*>. Voice communication between both spacecrafts was established a little later.

<…*Hello. Soyuz, Apollo…*> Stafford said in Russian. Kubasov replied in English <...*Hello all. Hello Tom and Deke. Hello there Vance...*>

Communications among the crews of both ships were established using the language of the other, thus the Americans spoke Russian and the Soviets English. At 18:09 GMT ships rendezvoused and this maneuver was televised in real time. Stafford commented <...*We did it. Everything is excellent…*> cosmonauts answered <…*Soyuz and Apollo shake hands now...*>.

Fig. 5.3 Soyuz capsule

The docking was completed over the Atlantic at 18:12 GMT, 6 minutes before the flight plan time line. Millions of TV watchers around the world witnessed the fact. <…*Perfect, wonderful. Well done Tom. It´s been a good show. We are anxious to shake hands on board of Soyuz...*> said Leonov. Tass agency reported that Kubasov told his controllers that a little jolt was felt at the time of attachment but everything had gone per the flight plan otherwise.

Fig. 5.4 Slayton and Leonov

At 21:17 GMT the hatch number 3 opened; 2 minutes afterwards Apollo commander, Stafford, and Soyuz´s Leonov shake hands in space "Cold war had ended". Stafford said in Russian <...*Happy to see you...*>, <...*Very, very happy to see you...*> Leonov answered in English. <…*This is Soyuz and the USA...*> commented Slayton to TV viewers all over the whole world.

Soviet´s Premier, Leonidas I. Brezhnev, and USA President, Gerald Ford, congratulated the crews and confirmed their conviction of the success of the mission.

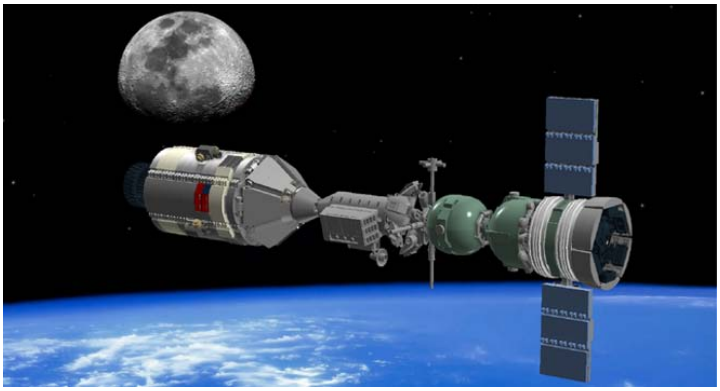

Fig. 5.5 Soyuz, ensamble module and Apollo CSM

Sttaford then presented Leonov with <…*five flags for your government and the people of the Soviet Union...*> with the wish that <…*our joint work in space be used for the benefit of all Countries and Earth people...*> Leonov presented then to the USA crew with soviet flags and commemorative plaques.

The crews signed international certificates and interchanged other gifts including UN flags and a peculiar present from Stafford. He convinced country singer Conway Twitty to record "Privet Radost" a Russian version of his hit "Hello, Darlin´". This recording was played to the world and in Mission Control somebody commented that <...*it sounded like it was from far western Oklahoma.....around Kiev...*> After nearly 4 hours of joint activities, including a meal aboard the Soyuz, Americans returned to

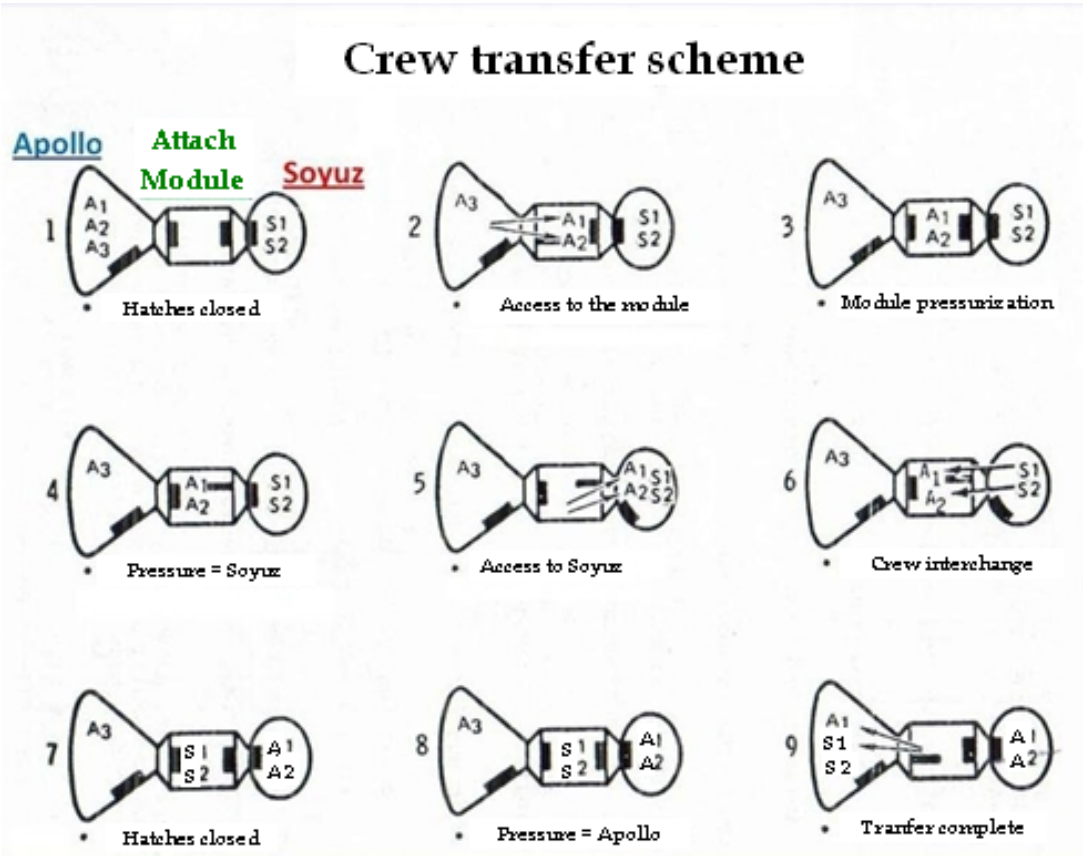

Fig. 5.6

the Apollo and the hatch closed at 00:51 GMT.

After the planned rest period, the crews prepared for another day of joint activities. Kubasov gave soviet TV viewers a description of the mission planning while the rest of the crews attended to the programmed experiments at their own capsules. At 11:05 GMT, July 18th, Brand went to the Soyuz while Leonov went into the Apollo greeting with a <...*Howdy partner*...> Kubasov gave a tour of the Soyuz to the American TV audience after which Stafford did the same with the Apollo to the Soviet TV audience. Kubasov and Brand recorded scientific experiments to be played back to ground later. They had lunch in the Soyuz capsule and Leonov, Stafford and Slayton had lunch in the Apollo.

During the third encounter, Stafford went into the Soyuz and Kubasov went into the Apollo. Brand gave a geography class of the east of the USA, as seen from Earth orbit, to soviet TV audience, in Russian.

There were more conferences and gifts interchanges from one crew to the other before the last handshake at 22:49 GMT on July 18th, when each crew returned to their own capsules. Hatches closed after Brand said to the soviet cosmonauts <...*We wish you the greatest of success. I am sure we have started a new era in history. Our next encounter will be back on the ground…*>

Fig. 5.7

The total amount of time, adding transfers and joint activities was 19 hours and 55 minutes. Stafford spent 7 hours and 10 minutes aboard the Soyuz, Brand spent 6 hours and 30 minutes and Slayton 1 hour and 35 minutes.

Leonov spent 5 hours and 43 minutes and Kubasov 4 hours and 57 minutes in the Apollo. During the almost two days of joint operations, the five crewmen worked in five joint experiments.

Space ships de-attached at 14:02 GMT July 19th. The crews took several pictures of both capsules and the ensemble module and transmitted them to ground.

Then, the Apollo maneuvered to block the Sun and thus simulate an eclipse which was photographed by the Soyuz.

Both ships attached again at 14:34 GMT. This time was not as smooth as the first one but caused no problems.

Other than the gifts considered "normal", they also exchanged beverages and typical foods of their place of origin.

Fig. 5.8 Gift Interchange

Leonov and Kubasov took with them food typical of their Tracking Stations: From Eupatoria, Ukrania, a borscht and cabbage soup; from Tsibilisi, Georgia, a lamb broth; from Kolpashevo, Russia, a spinach and sorrel soup and from Dzhusaly, Kazakhstan, caviar. Slayton, Brand and Sttaford, contributed with: spaghetti, bacon, apple pie and apricot pudding.

At 17:26 GMT last decoupling occurred with Soyuz being active. The UV atmospheric absorption experiment was activated during separation and, then, Apollo took pictures of the Soyuz. After the separation maneuvers were completed Leonov told Apollo <...*Thank you very much for your great job…It was a good show...*> Brand answered <…*Thanks to you as well. This was a great job…*>

Soyuz remained in orbit almost 30 more hours that the cosmonauts used to perform pre-programmed experiments. At 08:39 GMT they de-attached from the orbital vehicle and initiated the braking burn. Soyuz landed 11 km north-east of Baykonur at 12:51 GMT.

Apollo also remained in orbit performing pre-programmed experiments. One of the most important was the discovery of the first pulsar outside of the Milky Way.

After a couple of maneuvers, on July 23rd at 10:38 GMT, the CSM initiated the braking sequence. After separation of the service and command modules, Apollo splashed down west of Hawaii at 11:18 GMT. This was the last splashdown for American astronauts.

The primary objectives of ASTP were, among others: Confirm the viability of a rendezvous between an Apollo and a Soyuz, the ability of the crews to transfer between both vehicles and the capability of the Apollo to maintain space control of both crafts.


Fig. 5.9 Soyuz landing

These objectives were considered fulfilled on August 15th 1975.


Fig. 5.10 Apollo Splashdown

6. ACKNOWLEDGEMENTS

a. All photographs depicted in this essay are from public Internet publications and, in no way, they will be used to collect any income.

b. Thanks to my wife, Estrella, and daughters, Raquel and Sara, who always supported my intention of doing this writing and, actually, pushed me to not let it aside.

c. Thanks to late Dr. Bautista, late Pilar del Rio, Luis R. Gopegui, Luis Antón, Andrés Ripoll, late José Luis Fernandez and all the management at Fresnedillas and Robledo who trusted in my capacity for the job when I was hired.

d. Special thanks to my FRIEND James A. Hodder *(DSN OPS MGR at JPL)* who helped me in making my English writing understandable.

e. Special thanks to my late FRIEND Thomas L. Cleary *(Former image processor at JPL and USB Tech at Madrid PRIME and two of the Tracking ships during Apollo)* for his support on this project.

f. Special thanks to my FRIEND José Manuel Grandela. Without the help of his deep knowledge of this project and his experience after many hours of tracking this effort would not have been completed.

g. Special thanks to Vincent Terencio who was my mentor during my first days as a USB Tech at the Madrid WING Station.

h. Thanks to the Madrid WING team at Robledo, where I learned about Discipline, Competence, Confidence, Responsibility, Toughness and Teamwork. And who also helped me in building my attitude.

i. Thanks to all my friends at Fresnedillas and Robledo who helped me in doing my job easier by doing their jobs perfect.

j. Thanks to all those, Americans or Spaniards, who shared with me the thrill of the Space Race and were proud of being a part of History.

k. A special mention to my Friend José Araujo. His enthusiasm for all the NASA projects and, in particular, for the Space Race, is so contagious that made me consider seriously that such a part of History couldn't just go unnoticed. We must take into consideration that this is part of the History of Humanity, not just of a specific Country.

7. BIBLIOGRAFY

- *Slayton, Donald; Cassutt, Michael (1994). Deke! U.S. Manned Space: From Mercury to the Shuttle. New York: Forge. pp. 278–279.ISBN 0-312-85503-6. LCCN 94-2463. OCLC 29845663.*
- Committee on Aeronautical and Space Sciences, Soviet Space Programs, 1971–75. Washington: U.S. Govt. Print. Off., 1976.
- Debbora Battaglia, "Arresting Hospitality: the Case of the 'Handshake in Space'," Journal of the Royal Anthropological Institute vol. 18 issue 1 June 2012. p. S76-S89
- Jennifer Ross-Nazzal,"Détente on Earth and in Space: The Apollo-Soyuz Test Project," Organization of American Historians Magazine of History, September 2010, Volume 24, Issue 3, pp. 29 – 34.
- Agreement Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes: Moscow, 24 May 1972. Moscow: NASA, 1972.
- *"Apollo-Soyuz". nasa.gov.*
- *"HEASARC Missions". nasa.gov.*
- http://www.jsc.nasa.gov/history/oral_histories/StaffordTP/TPS_BIO.pdf
- http://www.jsc.nasa.gov/history/oral_histories/BrandVD/BrandVD_Bio.pdf
- *Edward Clinton Ezell; Linda Neuman Ezell (1978). "The Partnership: A History of the Apollo-Soyuz Test Project". NASA.Archived from the original on 24 May 2011. Retrieved 4 May 2011.*
- Froehlich, Walter. *Apollo Soyuz*. NASA EP-109, 1976.

8. GLOSSARY OF TERMS

ACCEUOSPP	**Agreement Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes**
ARIA	**Advanced Range Instrumentation Aircraft**
ASTP	**Apollo-Soyuz Test project**
ATS	**Applications Technology Satellite**
CM	**Command Module**
CSM	**Command and Service Module**
Fresnedillas	**City 56 km west of Madrid. Home of the Fresnedillas MSFN (later joined the STDN). Better known as Madrid MSFN.**
GMT	**Greenwich Mean Time**
Hg	**Element Mercury**
INTA	**National Aerospace Technical Institute**
JSC	**Johnson Space Center**
mm	**millimeters**
MSFN	**Manned Space Flight Network**
STDN	**Space Tracking and Data Network**
Tass	**Russian News Agency**
UHF	**Ultra High Frequency**
UV	**Ultra Violet**
VHF	**Very High Frequency**