The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST

	Administrative information and document control	
1.1	Date of this submission	07-Jul-2026 (under informal review by AMSAT prior to submission to IARU)
1.2	Submission revision number	0

	Spacecraft identification	
2.1	Name	Solar Flare and Ionosphere Explorer (SoFIE) CubeSat
2.2	Notifying administration	FCC
2.3	API/A number	Our project is structured as an FCC Part 5 Experimental filing due to a scientific 9.303 MHz topside sounding instrument. However, our UHF and S-band communications are designed to support public amateur data access. The complete ITU API database has been compiled via SpaceCap, fully cleared through BRSIS-Validation v10.0.9, and was submitted to the FCC on 7/11/26 under the network name SOFIE.

	Licensee of the space station or responsible amateur in case of educational mission	
3.1	First (given) name?	Kevin
3.2	Last (family) name?	Suresh
3.3	Amateur radio call sign	KD3DHW
3.4	Licensed since?	05-Jun-2026
3.5	Postal address?	Saint Francis University, 132 Franciscan Way, PO Box 600, Loretto, PA – 15940.
3.6	Telephone number (including country code)?	+1 814 935 0199
3.7	E-mail address?	kxs602@francis.edu
3.8	By signing here, the licensee	Signature:

	accepts that, except for the telecommand information, the IARU may publish all the information contained in this application.	Date: 7/11/26

	Organizations — complete this section for EACH participating organization	
4.1	Name of organization and/or educational institution?	Saint Francis University
4.2	Licensee's position in any organization referenced in item 4.1?	Student at Saint Francis University. Communications Systems and Ground Station Lead – SoFIE.
4.3	Postal address?	MECS - Saint Francis University, 132 Franciscan Way, PO Box 600, Loretto, PA – 15940.
4.4	Telephone number? (including country code)	+1 508 963 3408
4.5	E-mail address?	rise@francis.edu
4.6	Web site URL?	https://sites.google.com/francis.edu/cubesat
4.7	National Amateur Radio Society (including contact information)?	ARRL arrl.org
4.8	Does your National Amateur Satellite organization and/or National Amateur Radio Society endorse this request?	National AMSAT Organization X yes no National Amateur Radio Society X yes no
4.9	Name and email address(es) of the person(s) you've contacted in the National AMSAT Organization or National Amateur Radio Society?	ARRL Name: Steve Goodgame, K5ATA Email: arrl.org AMSAT Name: Andrew Glasbrenner, KO4MA Email: aglasbrenner@amsat.org
4.10	Will any person or organization involved with the project be, directly or	yes, see 4.11 X no

	indirectly, financially compensated for operating the satellite and ground station(s)?	
4.11	If you've answered yes in 4.10, please explain:	N/A

	Space station mission and frequencies	
5.1	Type of mission? Tick applicable box(es):	Amateur X Amateur combined with Educational Amateur combined with other mission(s)
5.2	If mission type in given in 5.1 is Amateur combined with other missions, will the transmitters or receivers operating in the amateur radio frequencies be used to control, or retrieve data (telemetry, payload, etc.) from, the non-amateur mission sub-systems?	yes, see 5.3 No N/A
5.3	If you've answered yes in 5.2, please explain:	N/A
5.4	List and describe the project mission(s):	The primary objective of our CubeSat mission is to expose SFU's students to the art and science of developing a space flight mission as a part of the undergraduate experience and encourage them to pursue careers in Science, Technology, Engineering, and Mathematics (STEM). This objective is extended to local high school students by providing them an opportunity to build, test, and fly two experiments as a part of the mission. Finally, the STEM objective is also extended to the global amateur radio operator community by providing opportunities for them to become Citizen Scientists and conduct joint experiments throughout the mission lifetime. The science objective of the SFU-1 mission is to investigate how solar flares and solar activity affect the upper region of the Earth's atmosphere – the ionosphere. To do this, the spacecraft will observe HF radio burst

		emissions from the Sun, known to be associated with solar flares. The spacecraft will also observe radio transmission from the ground. Comparing emissions from the Sun to ground-based transmissions, we will be able to determine how the ionosphere is changing as a function of solar activity. Finally, SoFIE is a hybrid mission utilizing a secondary, independent payload (a 9.303 MHz topside sounding instrument authorized under an FCC Part 5 Experimental license). The primary communications, telemetry, tracking, and control (TT&C) loops utilize coordinated UHF and S-band amateur-satellite service frequencies to provide open, unencrypted data access and educational orbital tracking for the global amateur radio community.
5.5	Explain in plain text how your mission(s) complies with provisions no. **1.56**, **1.57** and **25** (see Annex 1); how will your mission contribute to the advancement of the amateur satellite service; and how will amateur operators around the globe be able to participate in your mission, besides just receiving the satellite telemetry?	The SoFIE mission offers extensive, high-value opportunities for amateur radio operators globally to contribute to science, education, and technology development. Operators are invited to become active collaborators and members of the SoFIE team through several key activities: • Individual or Team Experiments: Operators may participate as individuals or form local groups or regional teams to design and execute unique transionospheric experiments. This flexibility allows, for example, a single operator to test a new antenna/transmitter design, while a large club or multiple clubs can coordinate complex, multi-station transmissions to evaluate radio propagation as a function of time and/or space (e.g., time of flight, Doppler shift, Faraday rotation, scintillation, fading, and absorption). • Novel Operating Approaches: The deterministic orbit of the CubeSat allows for the coordination of specific operating windows days in advance. Operators can test novel approaches such as: Single-Frequency Probing: Multiple transmitters aligned along the ground track to study signal attenuation variations. Multi-Frequency/Clustered Operations: Teams clustered in a local area (e.g., during

		Field Day) transmitting across multiple frequencies to analyze a regional snapshot of the ionosphere. SoFIE Transmissions: During appropriate ionospheric conditions, ground operators can plan experiments around the reception of 9.303 MHz transmissions from SoFIE using matched filtering techniques. Unproven Methods: The SoFIE program explicitly welcomes the use of new or creative approaches to gain fresh insights into HF propagation. New contests could also be coordinated by creative amateur operators with the SoFIE CubeSat as a mobile receiver. Such contests would be exciting and challenging, while yielding useful ionospheric propagation insights. • Analysis of Mission Data: To foster a collaborative research environment, all mission data will be made publicly accessible to the community. This openness empowers operators to transition from contributing to experimentation to performing data analysis and predictive modeling of radio propagation. Participants are encouraged to lead investigations into their own experimental findings or join larger research teams, such as HamSCI, to explore broader ionospheric phenomena.
5.6	Amateur satellite bands used:	144-146 MHz X 435-438 MHz 1260-1270 MHz X 2400-2450 MHz 3400-3410 MHz 5650-5670 MHz and/or 5830-5850 MHz 10.450-10.500 GHz 24.000-24.050 GHz Other (please list)
5.7	Planned duration of each part of the mission?	Checkout – 2 month Operations – 16 months
	Proposed space station transmitting (space-to-Earth and/or space-to-space) frequency plan. Provide the following information for each frequency or frequency range:	
5.8	List all the frequencies (or frequency bands) requested and describe the function of each:	**UHF** 435-438 MHz Function: Downlink telemetry data that includes health status of the spacecraft.

		S-band 2400 - 2450 MHz Function: To downlink science payload and mission data that can be sent to the Science team for analysis.
5.9	Frequency tuning range (in MHz) of transmitter and tuning step increment (in Hz or kHz)?	**UHF** **Tuning Range:** 435 – 438 MHz **Step Increment:** 2.4 Hz **S-band** **Tuning Range**: 2440 – 2450 MHz **Step Increment**: 2.4 Hz
5.10	E.I.R.P (in dBm) of each transmitter?	**UHF: 30 dBm** **S-band: 28.5 dBm**
5.11	List all ITU emission designator for each transmitter:	**UHF: 23K1G1D [9600 bps, BPSK, BCH]** **S-band: 840KG7D [1Mbps, QPSK, BCH]**
5.12	Common description of the emissions including modulation type AND data rate?	**UHF Frequencies :** Modulation Type: AX 25 BPSK Data Rate: 9600 bps **S-Band Frequencies:** Modulation Type: CCSDS QPSK Data Rate: 1 Mbps
5.13	Type of antenna, antenna gain and radiation pattern?	**UHF** **Antenna Pattern: Dipole (156.2 degrees)** **Antenna gain: 3.1 dBi** **S Band** **Antenna Pattern: Patch (60 degrees)** **Antenna gain: 7.34 dBi**
	Proposed space station receiving (Earth-to-space and/or space-to-space) frequency plan. Provide the following information for each frequency or frequency range:	
5.14	Requested receive frequency and function?	Requested frequency of satellite receiver(s). **UHF:** 435 – 438 MHz **Function:** To uplink commands to the spacecraft.
5.15	Frequency tuning range (in MHz) of receiver and tuning step increment (in Hz or kHz)?	**UHF** **Tuning Range:** 435 – 438 MHz **Step Increment:** 2.4 Hz

5.16	ITU emission designator for each transmitter and emission type?	**UHF: 23K1G1D [9600 bps, BPSK, BCH]**
5.17	Common description of the emission including modulation type AND data rate for each transmitter and emission type?	**UHF Frequencies :** Modulation Type: AX 25 BPSK Data Rate: 9600 bps
5.18	Noise temperature for each receiver onboard the satellite?	**441.6 K**
5.19	Associated antenna gain and radiation pattern for each receiver onboard the satellite?	**UHF** **Antenna Pattern: Dipole (156.2 degrees)** **Antenna gain: 3.1 dBi**
	Other information	
5.22	Physical structure of the space station, including dimensions and mass?	SoFIE is a 3U CubeSat with two deployable 3U x2U solar panels. The current mass estimate is 4.0 kg, including mass growth allowance.
5.23	Functional Description of each satellite sub-system, including non-amateur payloads?	The SoFIE CubeSat includes the following subsystems: 1.Electrical power system (solar arrays, battery, voltage generation and distribution board) to generate and distribute power. 2.On board computer to coordinate spacecraft activities, including communications and attitude control. 3.Communication subsytem (Epiq Z2 SDR, EXA SST01 UHF transceiver and UHF and S-band antennas). 4.Sun sensors, IMU and magnetorquers for attitude determination and control. 5.GPS for position determination. 6.Rasberry Pi4 for payload commanding and data collection. 7.Power switch board for instrument power control. 8.Two imagers for aurora imaging.

		9. Soft X-ray sensor for solar flare detection. 10. HF receiver (3-30 MHz) for solar radio burst detection and transionospheric experiments. 11. Orthogonal dipole antenna deployer to extend 5 m tip to tip HF dipole antennas. 12. Single frequency topside sounder (~9.303 MHz). We are working with the FCC directly for frequency allocation.
5.24	Electrical Power budget. (average power consumption and power generation in Watts)?	Orbit average power generation = 4 1Ux3U solar arrays = 13.55 W Orbit average power consumption = 5.78 W Margin = 134%
5.25	Method of attitude stabilization (if used)?	3 axis magetorquers will be used for pointing. Sun sensors and IMU also included for attitude determination.
5.26	Service area?	Global Service Area. Ground Station at Saint Francis University and leveraging SatNOGS for downlinks.

	Encryption of downlink?	
6.1	Will all transmissions from the satellite have published and publicly available details on the project web site? (Note: The signal **must not** be effectively encrypted by not providing the necessary information. See No. **25.2A** in Annex 1)	X yes no, see 6.2 Downlink will not be encrypted
6.2	If you've answered no in 6.1, please explain:	N/A
6.3	Contact details of the person responsible for publishing the descriptions of modulation, protocol, format, etc.?	Kevin Suresh
6.4	By signing here, the responsible person listed in 6.3, agrees that the details required in 6.1 will be made publicly and freely available.	Signature: Date: 7/11/26

	Telecommand Information (NOT published)	
7.1	Telecommand station amateur radio callsign?	For operating in amateur bands, the call sign for transmitting to the satellite will be through the individual call sign of each mission operator. The SFU ground station will not have its own registered license.
7.2	Physical location of station antennas, including latitude and longitude?	SFU Ground Sation on Campus, Loretto, PA 15940. **Latitude: 40.504612° N** (40° 30' 17" N) **Longitude: 78.640901° W** (-78.640901° or 78° 38' 27" W)
7.3	Proposed space station telecommand frequencies?	**UHF Range:** 435 – 438 MHz
7.4	List all ITU emission designators for each transmitter:	**UHF: 23K1G1D [9600 bps, BPSK, BCH]**
7.5	Common description of the emission including modulation type AND data rate?	**UHF Frequencies:** Modulation Type: AX 25 BPSK Data Rate: 9600 bps
7.6	Radio Link budget(s):	https://sites.google.com/francis.edu/cubesat
7.7	A general description of any telecommand encryption:	Uplink commands will be authenticated using a unique token to maintain the integrity of spacecraft control by the student led team. The unique codes will be generated dynamically based on the HMAC-SHA256 (Hash-based Message Authentication Code) approach.
7.8	Explain how telecommand stations will turn off the space station transmitter(s) immediately, even in the presence of user traffic and/or space station computer system failure. See No. **22.1** in Annex 1.	The UHF receiver will always be on so the spacecraft can listen for commands at any given time. When the satellite is over the SFU ground station, it can accept individual commands sent by the student team only. The UHF transceiver can set a max transmit time as well as a maximum transmit inhibit

		time. These are both settings on the hardware and therefore operate independently of the satellite's on board computer. Therefore, if the on board computer fails, the transceiver will still turn off. The S-Band transmitter will only transmit when its buffer is populated and there is data to send. Data is pulled into the buffer by the satellite computer. In the event of an on-board computer failure, the transmitter would stop receiving data, and therefore, it would be incapable of sending telemetry to the Earth Station. In this state, the transmitter would simply remain on until it times out and turns itself off.
7.9	Explain the mechanism to ensure the space station is turned off in the event communications is lost with the command station.	The space station will remain powered if communication is lost with the command station. However, flight software will prevent transmissions beyond short beacon telemetry bursts over UHF from occurring unless a ground station command is received to transmit in UHF or S-band.

	Telemetry frequencies	
8.1	All amateur telemetry frequencies or frequency bands used in the mission?	UHF: 435-438 MHz S-Band: 2440-2450 MHz
8.2	ITU emission designators:	**UHF: 23K1G1D [9600 bps, BPSK, BCH]** **S-band: 840KG7D [1Mbps, QPSK, BCH]**
8.3	Common description of the emission including modulation type AND data rate?	**UHF Frequencies :** Modulation Type: AX 25 BPSK Data Rate: 9600 bps **S-Band Frequencies:** Modulation Type: CCSDS QPSK Data Rate: 1 Mbps
8.4	Radio Link budgets:	https://sites.google.com/francis.edu/cubesat

8.5	Transmission formats e.g. AX25 etc.? Provide any other details required to understand the telemetry transmission:	UHF: AX25 S-band: CCSDS

	Launch plans	
9.1	Launch agency?	NASA
9.2	Launch location?	VAFB or KSC
9.3	Expected launch date?	No earlier than 6/2028
9.4	Planned orbit apogee?	500 km
9.5	Planned orbit perigee	500 km
9.6	Planned orbit inclination	97.4 degrees
9.7	Planned orbit period	97.4 minutes
9.8	List other amateur satellites expected to share the same launch (if known):	Unknown

	Typical Earth station — transmitting	
10.1	Describe the hardware and software of a typical Earth station to transmit signals to the planned satellite:	The transmitting earth station delivers all operations schedules and control commands to the satellite. All schedules are sent during times when the satellite is scheduled to pass over the Earth Station. The Earth Station will track the satellite and propagate its orbit to verify when it is overhead and establish a link between the satellite and the Earth Station. Those operating the Earth Station must be licensed to transmit to the satellite. Typical ground station UHF HW/SW for transmission includes GNU radio and

		Gpredict, SDR, power amplifier, high isolation switch, and a UHF antenna.
10.2	Radio Link budget. Show complete link budgets for all Earth station transmitting frequencies, except telecommand.	https://sites.google.com/francis.edu/cubesat

	Typical Earth station — receiving	
11.1	Describe the hardware and software of a typical Earth station to receive signals from the planned satellite.	Earth Stations which receives signals from the spacecraft have an antenna and a radio which are tuned to the satellite's frequency band and intercept signals over the air. The receiving station will demodulate the data for it to be processed and decrypt it, if necessary. This allows the Earth Station operator to receive data from the spacecraft on its health and science data. Typical UHF receive HW/SW includes GNU radio and Gpredict, SDR, low noise amplifier (downlink), high isolation switch, and a UHF antenna. Typical S-band receive HW/SW includes GNU radio, SDR, low noise amplifier, cavity filter, downconverter, and antenna w/ feedhord.
11.2	Radio Link budget. Show complete link budgets for all Earth station receiving frequencies.	https://sites.google.com/francis.edu/cubesat

	Additional information: Do not attach large files. Indicate the URL where the information is available.
12	Please, supply any additional information that may assist the Satellite Advisor to coordinate your request(s). N/A

	Certification: **Please tick ONE appropriate box.**
13	X The licensee of the planned space station has reviewed all relevant laws, rules, and regulations, and certifies that this request complies with all requirements as understood by IARU to the best of his/her knowledge and confirms to meet the requirements of RR 1.56 and RR 1.57 in that the proposed satellite will operate without pecuniary interest. **Please list any commercial interests. If none, please state none.** **None**
	The licensee of the planned space station has reviewed all relevant laws, rules, and regulations and disagrees with IARU interpretations of Treaty requirements. The IARU Satellite Advisor is asked to consider the following interpretation. Explanation follows.

	Signature	
14		Date 7/11/26

Document History
29/4/2020: Revision of V39

Annex 1: Extracts from the ITU Radio Regulations

1.56 *amateur service:* A *radiocommunication service* for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

1.57 *amateur-satellite service:* A *radiocommunication service* using *space stations* on earth *satellites* for the same purposes as those of the *amateur service*.

ARTICLE 25

Amateur services

Section I − Amateur service

25.1 § 1 Radiocommunication between amateur stations of different countries shall be permitted unless the administration of one of the countries concerned has notified that it objects to such radiocommunications. (WRC-03)

25.2 § 2 1) Transmissions between amateur stations of different countries shall be limited to communications incidental to the purposes of the amateur service, as defined in No. **1.56** and to remarks of a personal character. (WRC-03)

25.2A 1A) Transmissions between amateur stations of different countries shall not be encoded for the purpose of obscuring their meaning, except for control signals exchanged between earth command stations and space stations in the amateur-satellite service. (WRC-03)

25.3 2) Amateur stations may be used for transmitting international communications on behalf of third parties only in case of emergencies or disaster relief. An administration may determine the applicability of this provision to amateur stations under its jurisdiction. (WRC-03)

25.4 (SUP - WRC-03)

25.5 § 3 1) Administrations shall determine whether or not a person seeking a licence to operate an amateur station shall demonstrate the ability to send and receive texts in Morse code signals. (WRC-03)

25.6 2) Administrations shall verify the operational and technical qualifications of any person wishing to operate an amateur station. Guidance for standards of competence may be found in the most recent version of Recommendation ITU-R M.1544. (WRC-03)

25.7 § 4 The maximum power of amateur stations shall be fixed by the administrations concerned. (WRC-03)

25.8 § 5 1) All pertinent Articles and provisions of the Constitution, the Convention and of these Regulations shall apply to amateur stations. (WRC-03)

25.9 2) During the course of their transmissions, amateur stations shall transmit their call sign at short intervals.

25.9A § 5A Administrations are encouraged to take the necessary steps to allow amateur stations to prepare for and meet communication needs in support of disaster relief. (WRC-03)

25.9B § 5B An administration may determine whether or not to permit a person who has been granted a licence to operate an amateur station by another administration to operate an amateur station while that person is temporarily in its territory, subject to such conditions or restrictions it may impose. (WRC-03)

Section II − Amateur-satellite service

25.10 § 6 The provisions of Section I of this Article shall apply equally, as appropriate, to the amateur-satellite service.

25.11 § 7 Administrations authorizing space stations in the amateur-satellite service shall ensure that sufficient earth command stations are established before launch to ensure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately (see No. **22.1**). (WRC-03)

ARTICLE 22

Space services[1]

Section I − Cessation of emissions

22.1 § 1 Space stations shall be fitted with devices to ensure immediate cessation of their radio emissions by telecommand, whenever such cessation is required under the provisions of these Regulations.

---

[1] **A.22.1** In applying the provisions of this Article, the level of accepted interference (see No. **1.168**) shall be fixed by agreement between the administrations concerned, using the relevant ITU-R Recommendations as a guide.