

**Sensors and actuators used:**

- Temperature: list in the tables from 8 to 11
- Heater: list in the tables from 8 to 11
- Level: LI660, LI670, LI680, LT682

**The user chooses:**

- Temperature setpoint: list in the tables from 8 to 11
- Flow: FT581limit, FT583limit
- Level: LI660mini, LI670mini, LI680mini

**Initial conditions:**

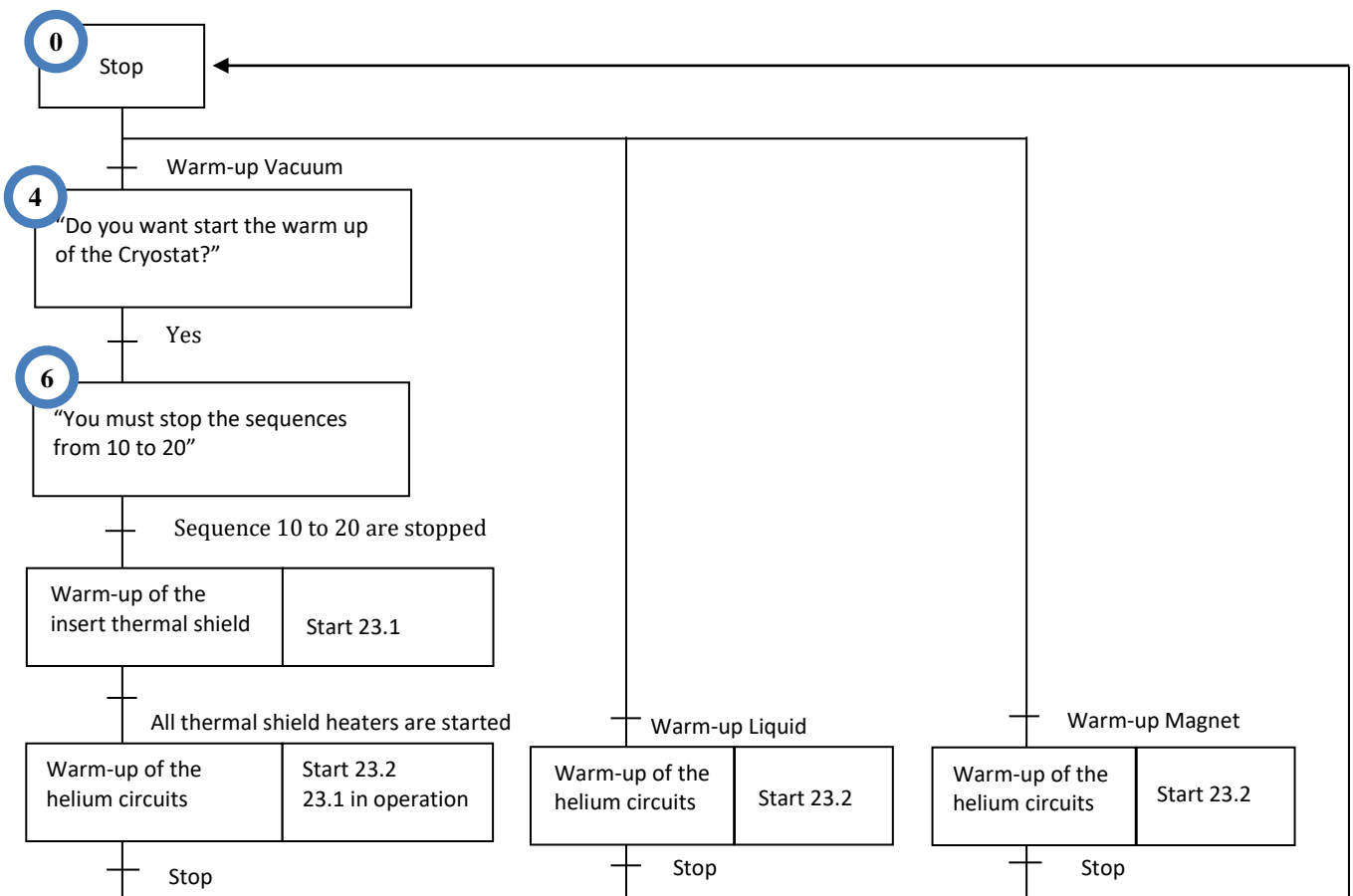
- Sequences from 1 to 3 stopped
- Sequences 6 and 7 stopped
- Sequences from 10 to 20 stopped
- Sequence 8 in operation

This sequence drives the electrical heaters implicated in the warm-up of the inserts. Each set of heaters has its own cycle. To limit the current draw when starting the heater, the sequences work this way: each set of heaters starts its cycle 10 seconds after the previous. The sequential starting of heaters may take several minutes. The cycles of heater control run in parallel until the user decides to stop the warm-up. The cycles then all stop at the same time.

The sequences used to warm-up the thermal shield and the helium circuits are very similar, but for the helium circuits warm-up, the program checks the helium level. As long as the cryostat or helium tank contains liquid helium, the heating is intermittent and allows evaporating the liquid stored in the cryostat or in the insert helium tank. The heating operates in continuous mode when the cryostat (helium tank) is empty (Liquid helium level < Liquid helium level mini).

The tables from 8 to 11 give the list of heaters implicated in the warm-up of the inserts.

The sequences 23.1 and 23.2 are started one after the other as described below:



## 23-1: Warm-up of the vacuum insert thermal shield

The sequence used for the warm-up of the vacuum insert thermal shield is similar to the warm-up of the valve box thermal shield sequence 21-1 and the cryostat thermal shield 22-1.

The sequence 23 in vacuum mode can start only when the cryostat thermal shield cooling (sequence 7) and the cryostat helium cooling sequences are stopped.

### Vacuum mode

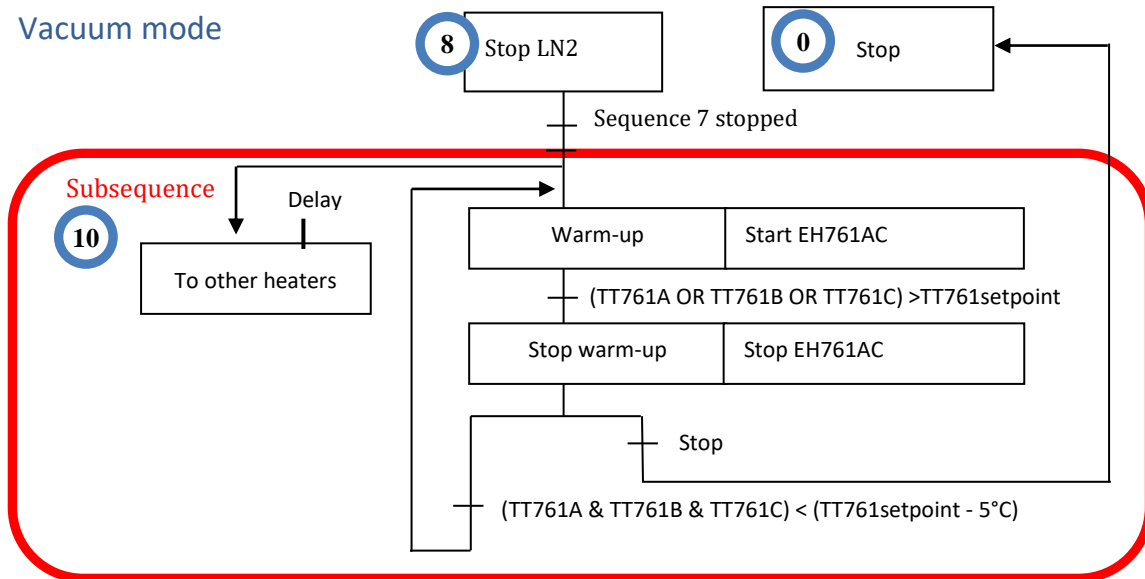


Table 8: Insert warm-up – Thermal shield – Vacuum insert

Heater	Thermometer	Temperature setpoint
EH761AC	TT761AC	TT761setpoint
EH763AF	TT763AF	TT763setpoint
EH765AC	TT765AC	TT765setpoint

## 23-2: Warm-up of the helium circuit

This sequence 23-2 is similar to the sequences Warm up Valve Box 21-2 and Warm-up Cryostat 22-2.

### Vacuum mode

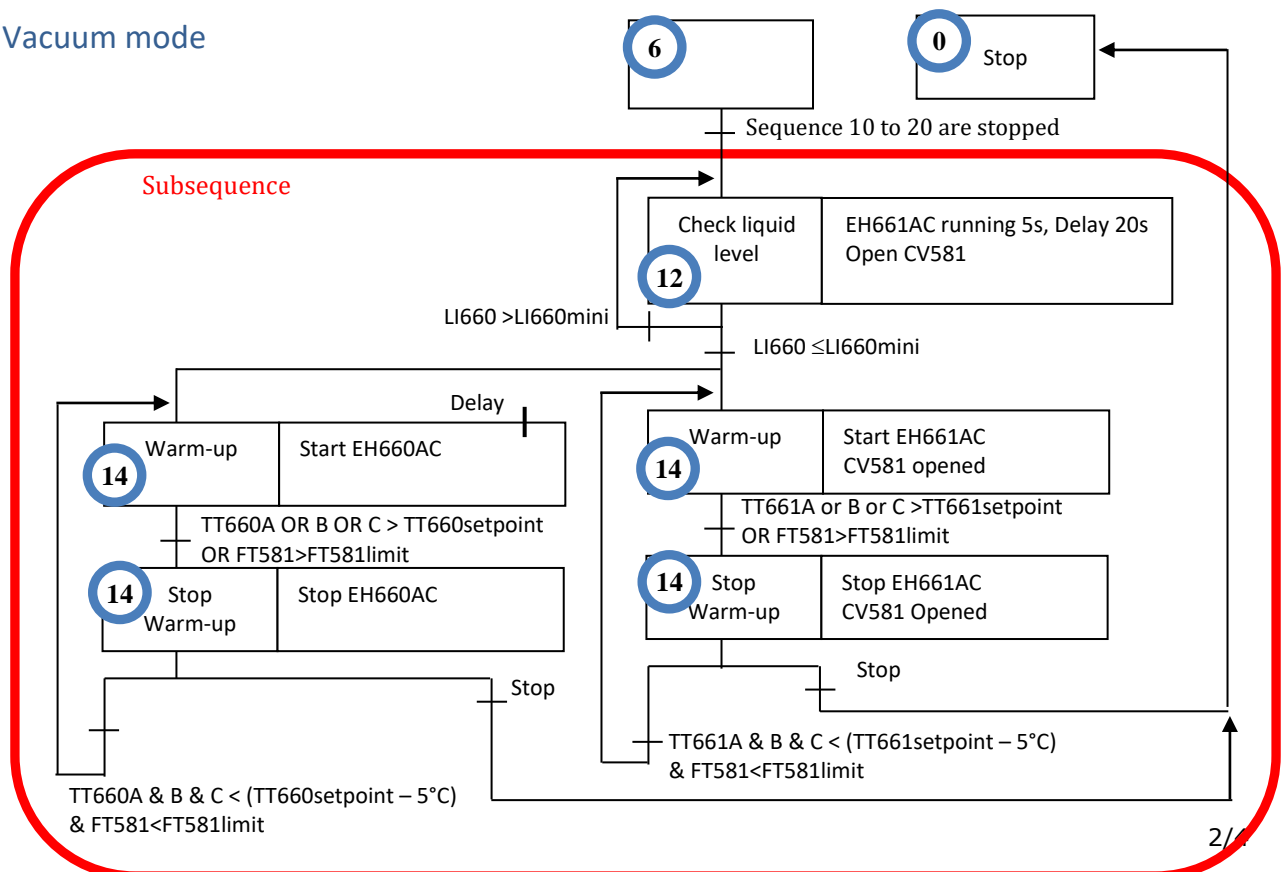


Table 9: Insert warm-up – Helium circuits – Vacuum insert

Heater	Pt thermometer	Level	Temperature setpoint	CX thermometer	Temperature threshold
EH660AC	TT660AC	LI660	TT660setpoint	TT663	50K
EH661AC	TT661AC	LI660	TT661setpoint	TT663	50K

## Liquid mode

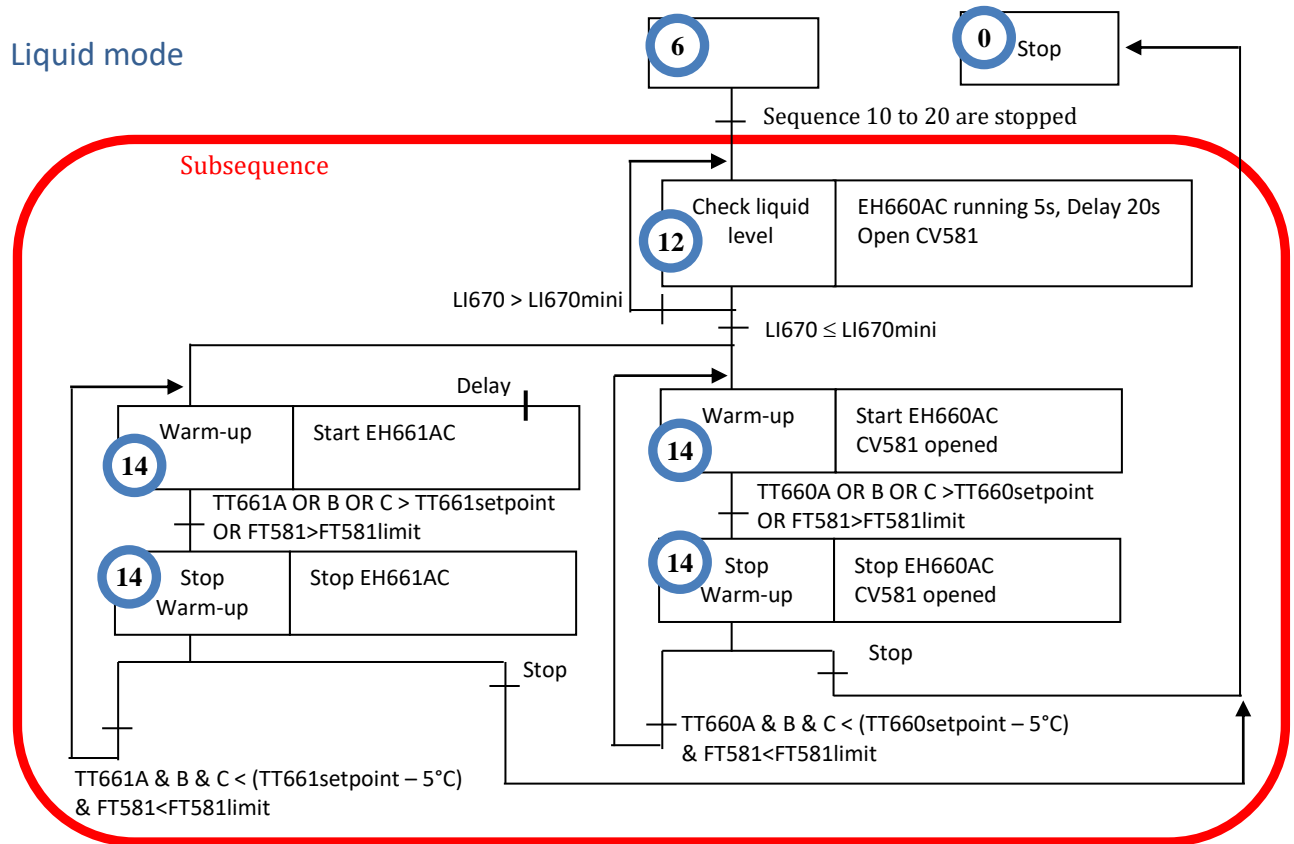


Table 10: Insert Warm-up – Helium circuits – Liquid insert

Heater	Pt thermometer	Level	Temperature setpoint	CX thermometer	Temperature threshold
EH660AC	TT660AC	LI670	TT660setpoint	TT663	50K
EH661AC	TT661AC	LI670	TT661setpoint	TT663	50K
EH670AC	TT670AC		TT670setpoint		

## Magnet mode

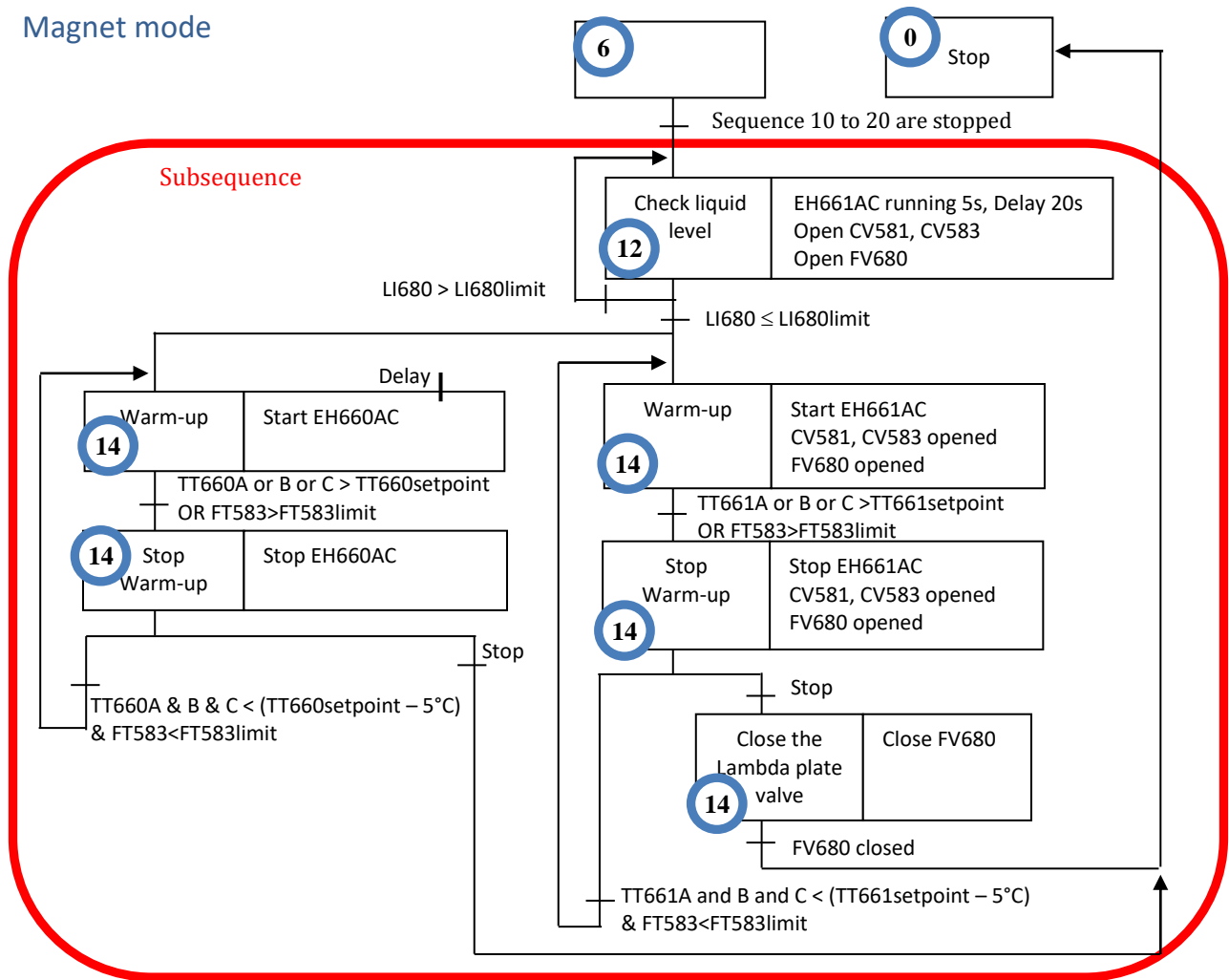


Table 11: Insert Warm-up - Helium circuits – Magnet insert

Heater	Pt thermometer	Level	Temperature setpoint	CX thermometer	Temperature threshold
EH660AC	TT660AC	LT682	TT660setpoint	TT668	50K
EH661AC	TT661AC	LI680	TT661setpoint	TT663	50K
EH680	TT680	LI680	TT680setpoint	TT685	50K
EH681AC	TT681AC	LI680	TT681setpoint	TT664	50K
EH682AC	TT682AC	LI680	TT682setpoint	TT664	50K
EH689AC	TT689AC	LI680	TT689setpoint	TT664	50K
EH670AC	TT670AC		TT670setpoint		