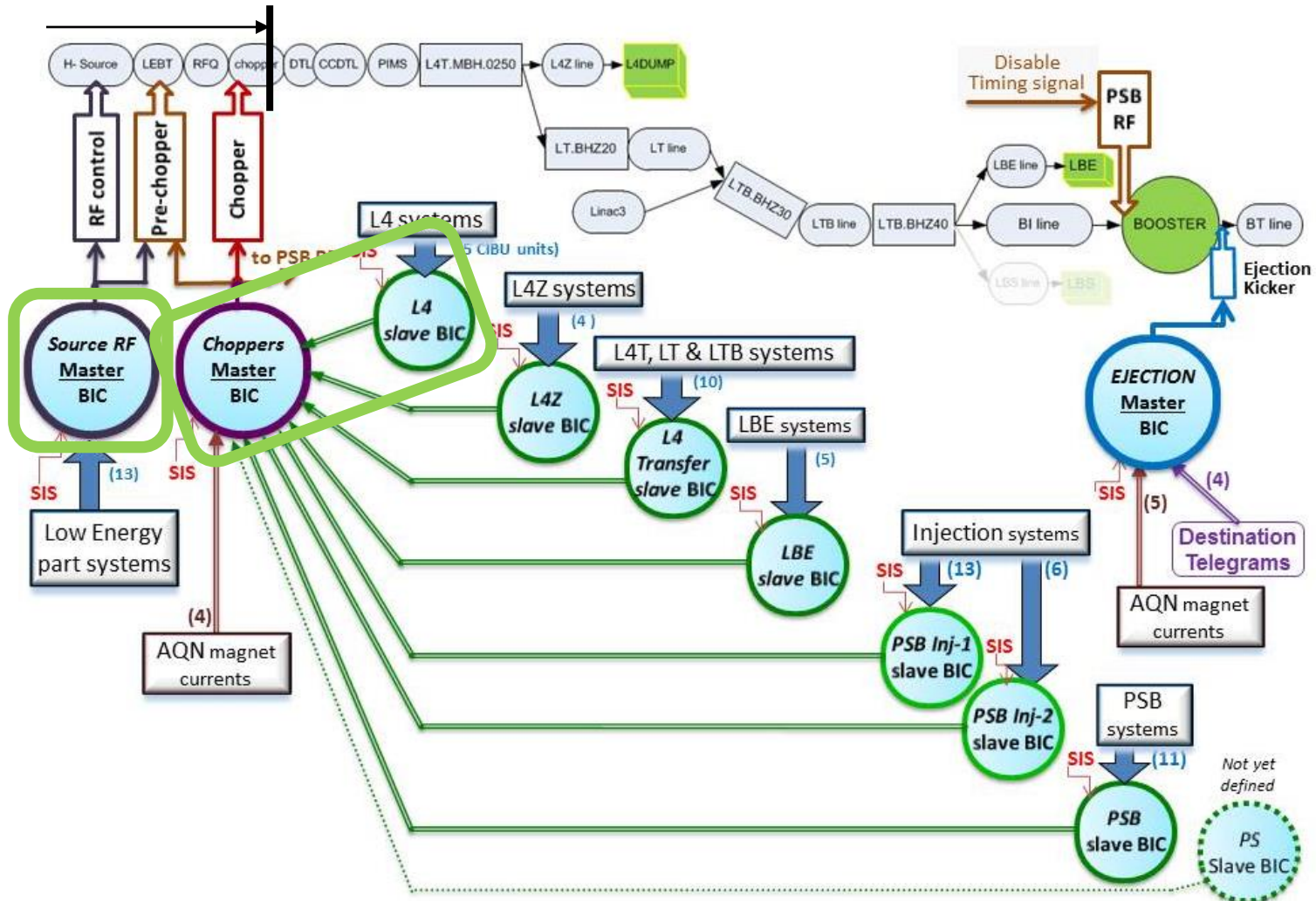# BIS installation in Linac4
For 50 MeV operation

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on behalf of TE/MPE-EP

MPP Linac4 – 9th July 2015

- For the 50MeV phase, the beam is stopped in the Chopper

- The BICs "Source RF", "Choppers" and "L4" are used.

- Modifications have to be implemented into both masters

Modifications for the Master BIC "Source RF"

Define a suitable BIC equation for the source start procedure:

"During a source start-up the nominal conditions are very different from those during standard operation; the beam stopper is "in" *and no BIS signal or interlock software should interfere with source operation until the completion of conditioning" (J.Lettry)*

Solution:

➢ 1) Install a new CIBU near the source

This CIBU named *Source Start* will be installed inside the source rack and will be manually controlled by a switch. The cable is already pulled; this solution will be operational for the 50MeV phase.

➢ 2) Add a new equation for the "Source RF" BIC

0	1	2	3	4	5	6	7	8	9	10	11	12	13
SIS	Source Start	Source Internal	Source HV	Pre-chopper	Source Beam Stoppers Out/Moving	Source Beam Stoppers In	Chopper	L4 Low-Energy Watchdog	L4 Low-Energy Vacuum Valves	L4L.ChopperQuads	RFQ	Commissioning Dump status	L4 Operator Veto
1	0	1	1	1	1	0	1	1	1	1	1	1	1
1	0	1	1	x	0	1	x	x	1	x	x	x	x
1	1	x	x	x	0	1	x	x	x	x	x	x	x

➢ <u>3) Add a new condition in the SIS</u>

Some signals are monitored by the SIS; during the source start these signals must be forced to TRUE.

<u>Important:</u>

While the *Source Start* gives a user permit to TRUE, the BIS is <u>not</u> responsible for the safety of the Source (*Source Internal* and *Source HV* are ignored).

<u>50 MeV implementation:</u>

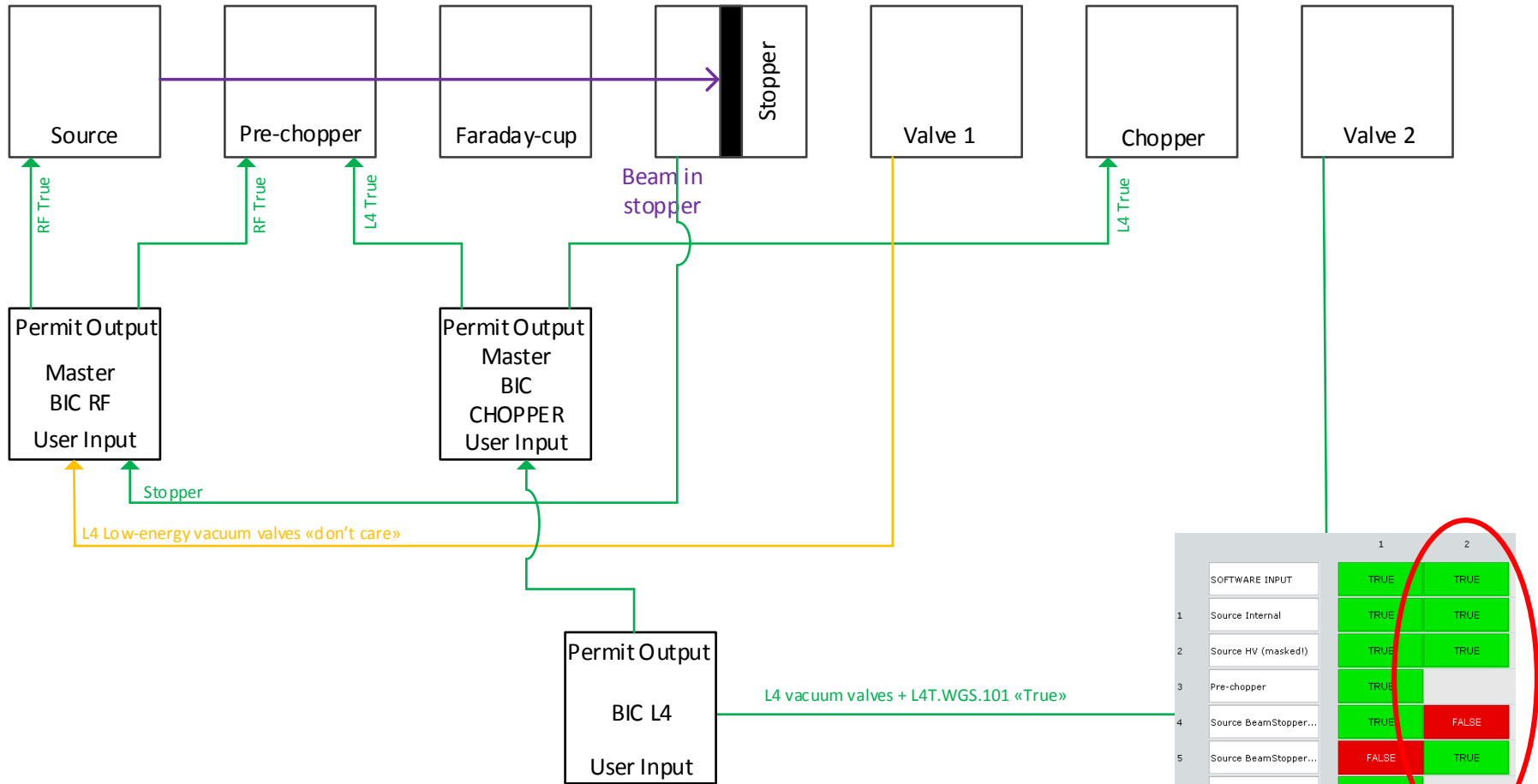| 0	1	2	3	4	5	6	7	8	9	10	11	12	13
SIS	Source Start	Source Internal	Source HV	Pre-chopper	Source Beam Stoppers Out/Moving	Source Beam Stoppers In	Chopper	L4 Low-Energy Watchdog	L4 Low-Energy Vacuum Valves	L4L.ChopperQuads	RFQ	CCC Operator Veto	L4 Operator Veto
1	0	1	1	1	1	0	1	1	1	1	1	1	1
1	0	1	1	x	0	1	x	x	x	x	x	x	x
1	1	x	x	x	0	1	x	x	x	x	x	x	x

Modifications for the BIC "Choppers"

Issue with the Beam Permit redundancy on the Pre-chopper:
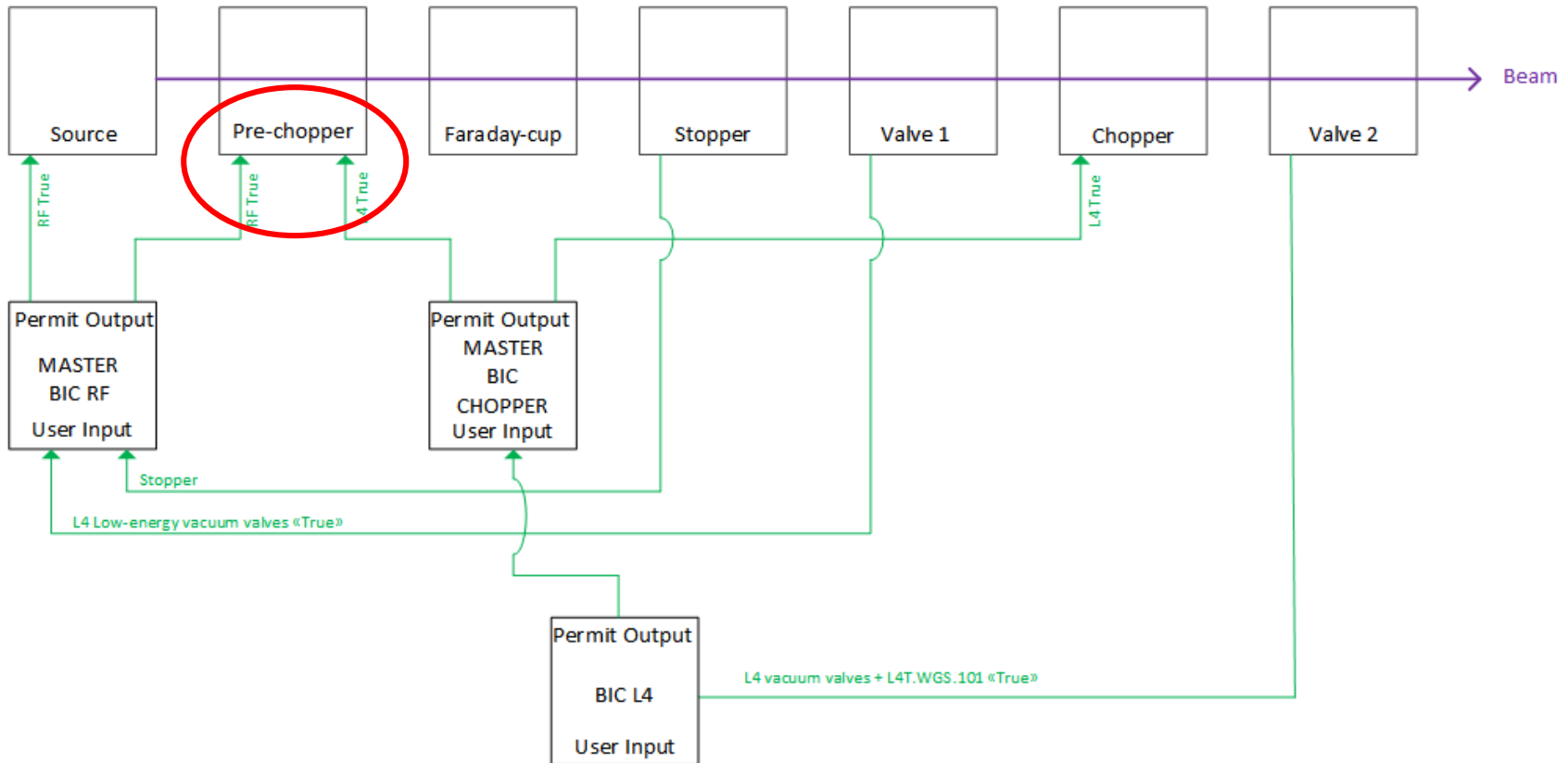
➢ In normal operating conditions the Pre-chopper receives 2 Beam Permit signals for redundancy reasons

➢ When downstream elements (like *Valve 1&2*) provide a User Permit to TRUE, the Beam Permit signals are both TRUE (all other User Permit signals must also be TRUE …)

✓ The BIS functionality is as expected in the Engineering specification

If the Stopper is "IN" position :

Diagram elements:
- Source
- Pre-chopper
- Faraday-cup
- Stopper
- Valve 1
- Chopper
- Valve 2

- RF True
- RF True
- L4 True
- Beam in stopper
- L4 True

Permit Output — Master BIC RF — User Input

Permit Output — Master BIC CHOPPER — User Input

Stopper

L4 Low-energy vacuum valves «don't care»

Permit Output — BIC L4 — User Input

L4 vacuum valves + L4T.WGS.101 «True»

|		1	2
	SOFTWARE INPUT	TRUE	TRUE
1	Source Internal	TRUE	TRUE
2	Source HV (masked!)	TRUE	TRUE
3	Pre-chopper	TRUE	
4	Source BeamStopper...	TRUE	FALSE
5	Source BeamStopper...	FALSE	TRUE
6	Chopper	TRUE	
7	L4 Watchdog	TRUE	
8	L4 Low-Energy Vacuu...	TRUE	
9	AQN L4L.QUADS (bou...	TRUE	
10	RFQ	TRUE	
11	Commissioning Dump	TRUE	
12	L4 Operator Veto	TRUE	

➤ The second equation of the BIC RF is selected (Beam Stopper IN), *Valve 1* is not taken into account

➤ If the *Valve 2* gives a User Permit to TRUE, The functionality is as expected, the beam is sent to the stopper (stability of the source)

Master BIC RF 8

If the Stopper is "IN" position but _Valve 2_ gives a FALSE:
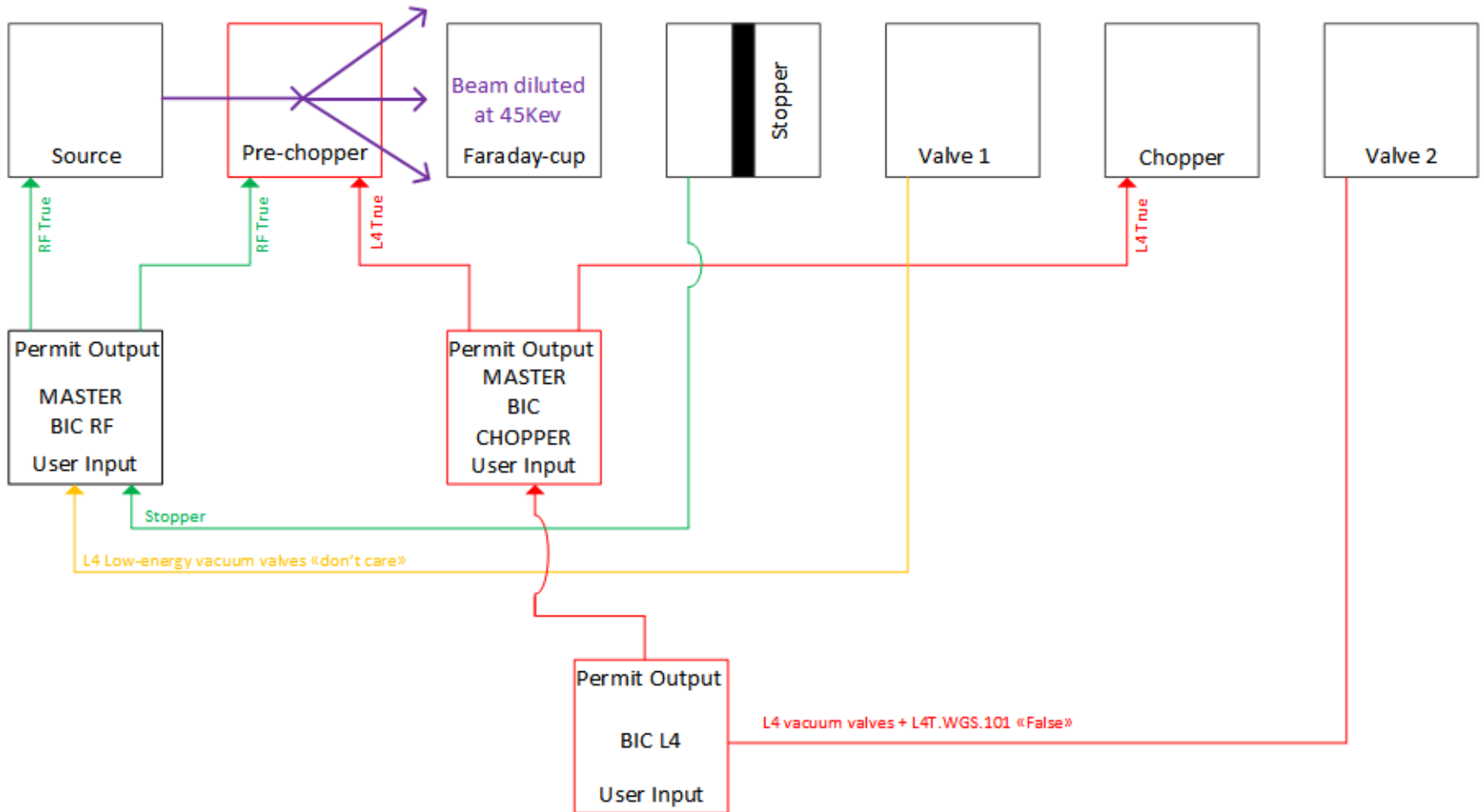
- ➢ The Pre-chopper is "stopped" and the beam is "diluted" at 45 KeV in the line.
- ➢ In these conditions the beam never reaches the faraday cup nor the stopper.

> The problem is the same with all other BICs + downstream elements (except the Ejection BIC). If one of the User permit goes to FALSE, the beam is diluted at 45KeV as the source is not stopped.
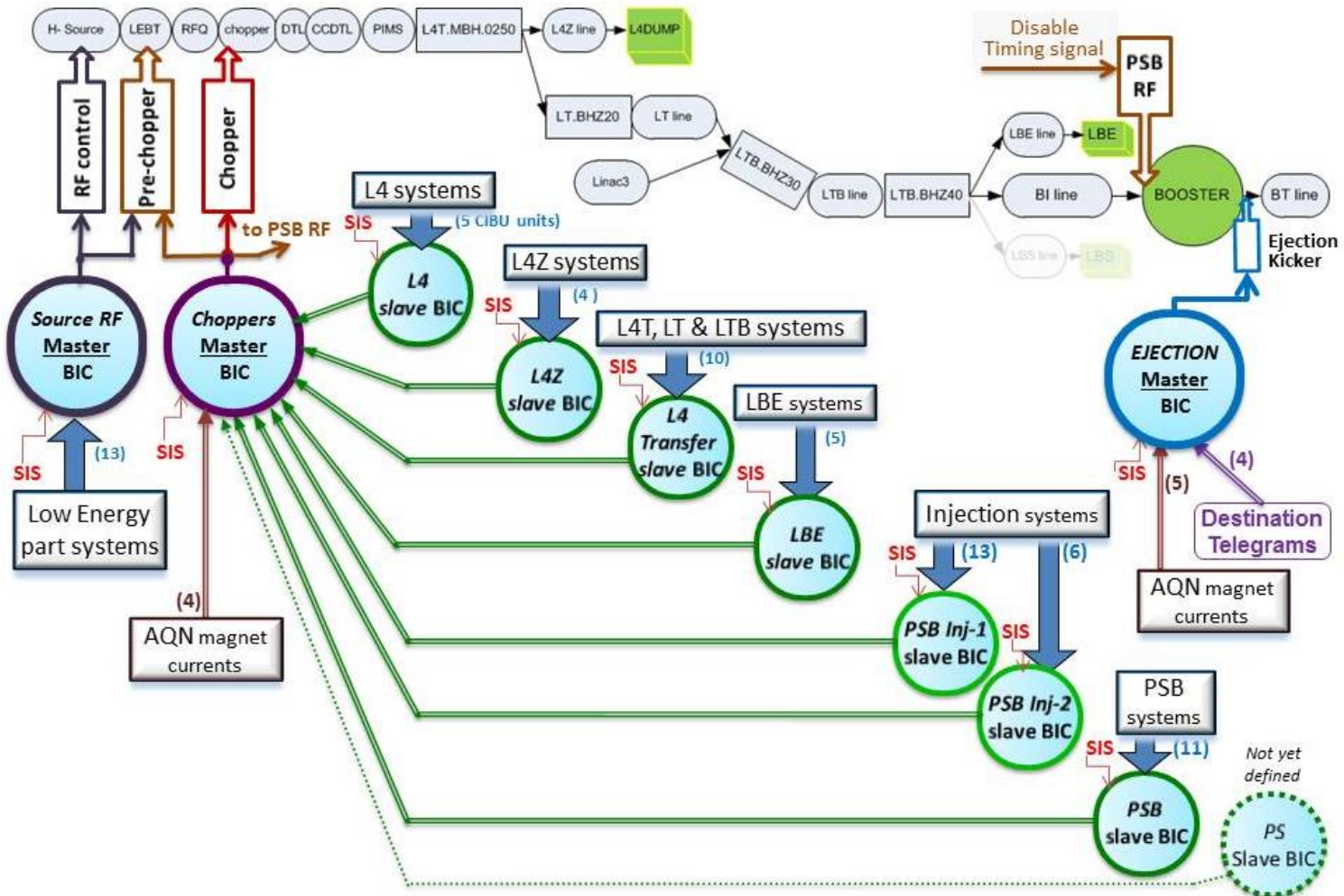
What we want:

➢ Keep redundancy on "Pre Chopper" for safety reason

➢ When the *Beam Stopper In* is TRUE,
the Beam Permit "Pre Chopper" must be TRUE

➢ When the *Beam Stopper Out/Moving* is TRUE,
the Beam Permit "Pre Chopper" must be TRUE only if all others users are
TRUE for the required destination

➢ => The User permits *Beam Stopper In* and *Beam Stopper Out/Moving*
have to be considered by the BIC "Choppers"

Solution:

> ➤ Add the 2 *Beam Stopper* signals to the "Chopper" BIC
> ➤ Add new equation "Beam to Stopper" to give a Beam Permit to TRUE when the Stopper is "IN"
>
> ➤ Remove the inputs *Destination PS* and *PS ok* (not enough place)
> ➤ Remove equation "Beam to PS"

50 MeV implementation:

- ➢ Master Chopper to install (before was only the L4 slave BIC)
- ➢ Two out of the Four equations will be used
- ➢ Two new connections for the Beam Stoppers
- ➢ L4 slave BIC is now only one of the inputs
- ➢ 3 CIBUs to install for inputs 4, 5 & 6 => forced permits (bouchon/strap)
- ➢ All other inputs not considered

Linac 4	
0	SIS
1	External Conditions (full pulse)
2	L4 Vacuum Valves + (L4T.VVGS.0101)
3	BLMs L4+L4Z
4	not used
5	WIC L4
6	Diamond Detector Test
7	not used
8	L4 RF
9	not used
10	not used
11	not used
12	not used
13	not used
14	not used
OUT	Linac4 OK

Linac 4 Choppers		Beam to Stopper	Beam to Dump	Beam to LBE	Beam to PSB
0	SIS	1	1	1	1
1	Source Beam Stoppers Out/Moving	0	1	1	1
2	Source Beam Stoppers In	1	0	0	0
3	Linac4 OK	x	1	1	1
4	AQN L4T.MBH_DUMP	x	1	0	0
5	L4Z OK	x	1	x	x
6	AQN L4T.MBH_LT	x	0	1	1
7	Linac4 Transfer OK	x	x	1	1
8	AQN LTB.BHZ40_LBE	x	x	1	0
9	LBE OK	x	x	1	x
10	AQN LTB.BHZ40_PSB	x	x	0	1
11	PSB Injection 1 OK	x	x	x	1
12	PSB Injection 2 OK	x	x	x	1
13	PSB OK	x	x	x	x
14	not used	x	x	x	x

} new connections

} forced permits

not considered

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