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Verification Report for the ISrc Control System

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1. INTRODUCTION

1.1 Purpose of the document

This document is the report on the Acceptance Test of the Control System of the source (ISrc) held in Catania the 5th July 2017.

2. SYSTEM CHARACTERISTICS

2.1 System purpose

The Ion Source installed in Catania is the first stage of the ESS Accelerator shown in Figure 1 and it has two main purposes:

- Generate the plasma
- Extract the beam at 75 KeV.

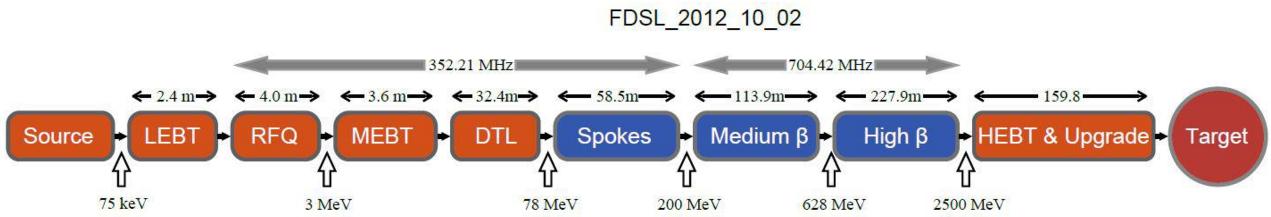

Figure 1 – ESS Accelerator

2.2 System overview

An overview of the control system for the ISrc is shown in Figure 2.

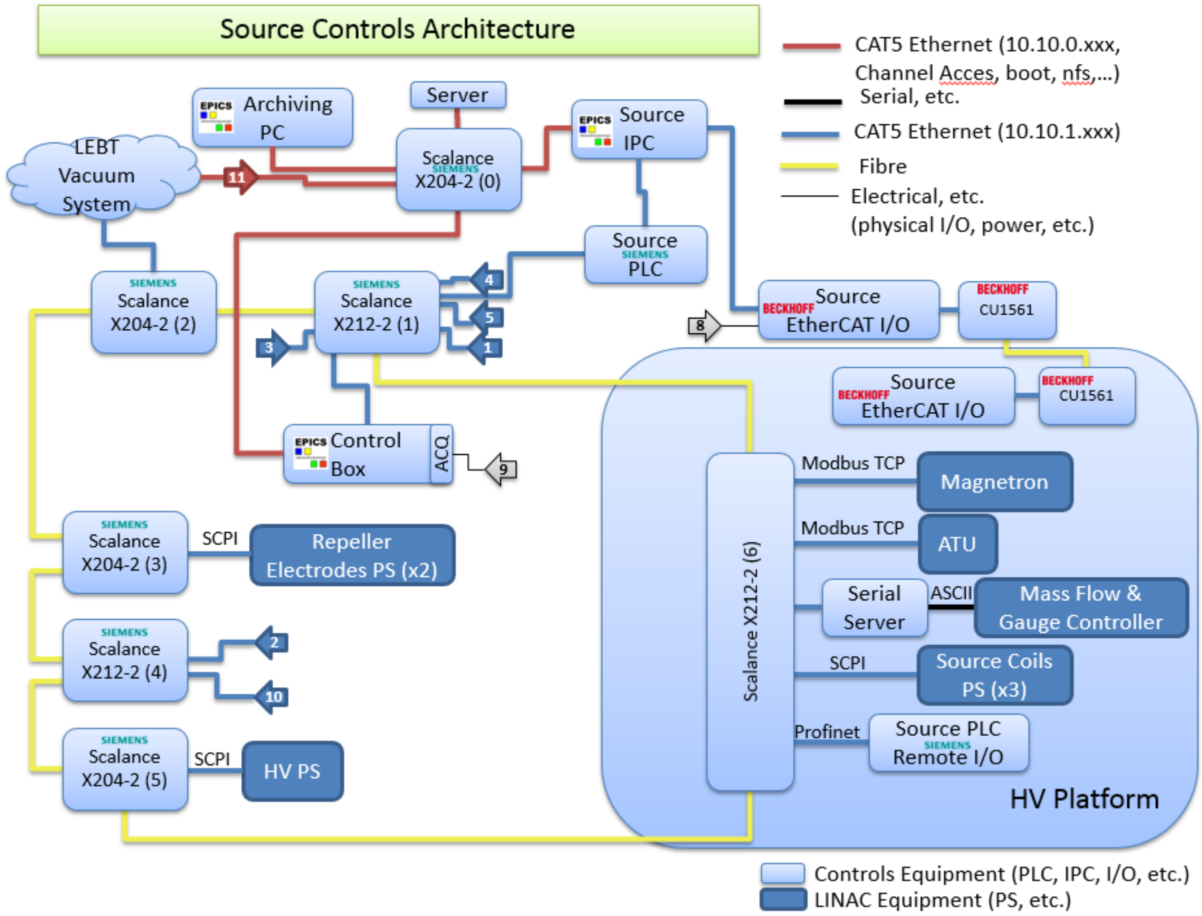

Figure 2 - Control System architecture

3. VERIFICATION REPORTS

The tests have been conducted using the automatic test tool WeTest [1] to run a well-defined set of predefined scenarios [2]. The reports generated by the WeTest tool are available in [3] and [4].

Some tests for the interlock has been performed following a manual procedure describe in sections 3.3, 3.4 and 3.5.

3.1 Test Case 1

3.1.1 Configuration

The first scenario (**source-at-pulsed.yml)** consists in configuring and running the source in pulsed mode. This test scenario runs the following test cases in sequence:

1. Set up of the source to a known states:
   a. source-at-0-reference.yml
2. Verify the status of the PLC:
   a. source-at-plc-status.yml
   b. lebt-at-plc-status.yml
3. Run the source in pulse mode:
   a. source-at-1-nominal-pulsed.yml
4. Verify the status of the PLC:

   a. source-at-plc-status.yml
   b. lebt-at-plc-status.yml
5. Switch of the source:
   a. source-at-switch-off.yml

3.1.2 Results

The result of the tests are reported in the PDF file [3] generated by the WeTest tool.

Some tests are failed but this was the expected behaviour in the current set up (some signals from the LEBT are missing and they are not in scope of the acceptance for the source).

3.2 Test Case 2

3.2.1 Configuration

The second scenario is similar to the previous and consists in running the source in continuous mode. This test scenario is contained in the **source-at-continuous.yml** and runs the following test cases in sequence:

1. Set up of the source to a known states:
   a. source-at-0-reference.yml
2. Verify the status of the PLC:
   a. source-at-plc-status.yml
   b. lebt-at-plc-status.yml
3. Run the source in continuous mode
   a. source-at-2-nominal-continuous.yml
4. Verify the status of the PLC:
   a. source-at-plc-status.yml
   b. lebt-at-plc-status.yml
5. Switch of the source
   a. source-at-switch-off.yml

3.2.2 Results

The result of the tests are reported in the PDF file [4] generated by the WeTest tool.

Some tests are failed but this was the expected behaviour in the current set up (some signals from the LEBT are missing and they are not in scope of the acceptance for the source).

3.3 Interlock test 1

The following interlock tests has been performed as described in 3.3.1:

If one of the temperatures measured on the platform exceeds the thresholds (adjustable) the magnetron and the power supplies must be put into OFF.

3.3.1 Configuration

1. The threshold on the graphical user interface of the source has been set to a lower value of the actual one.
2. Verify that a corresponding interlock is generated in the interlock page of the source
3. Verify that is not possible to clear the interlock generated

4. Set the threshold to a valid one
5. Verify that it is possible to clear any interlock generated and that it is possible to set the magnetron ON.

3.3.2 Results

An interlock has been generated setting the threshold to a lower value and it was not possible to clear the source of the interlock until the threshold was not set back to a good value. Test succeeded.

3.4 Interlock test 2

The following interlock tests has been performed as described in 3.4.1:

The ignition of the high voltage power supplies must be possible only if the vacuum is lower than a certain settable threshold.

3.4.1 Configuration

1. Set the vacuum of the source has in order to be invalid to generated the beam.
2. Verify that an interlock on the HV power supply is generated
3. Verify that it is not possible to clear the interlock without re-establish the good vacuum conditions.
4. Reset the conditions of the vacuum to a valid state to produce the beam.
5. Verify that it is possible to clear the source of the interlock and that it is possible to re-enable the HV power supply.

3.4.2 Results

An interlock has been generated as expected when the vacuum of the source wasn't in good conditions to generate to beam. It has been possible to clear the interlock and to re-enable to HV Power supply only when the vacuum on the source reached a good level to produce the beam. Test succeeded.

3.5 Interlock test 3

The following interlock tests has been performed as described in 3.5.1:

The ignition of the high voltage power supplies must be possible only if the access to the zone of high voltage is closed.

3.5.1 Configuration

1. Remove the security key from the HV platform.
2. Verify that an interlock is generated.
3. Open the door to access to the HV platform.
4. Verify that an interlock is generated.
5. Open one door of the cage of the source.
6. Verify that a new interlock is generated.
7. Verify that it is not possible to clear the different sources of interlock and that it is not possible to operate with the HV power supply.
8. Close the door of the cage of the source.
9. Close the door to access to the HV platform.

10. Insert the security key on the HV platform.
11. Clear all source of interlock.
12. Verify that it is possible to operate with the magnetron.

3.5.2 Results

All sources of interlock have been properly generated and it was not possible to clear them until they were not resolved. Test succeeded.

4. CONCLUSIONS

Both automatic and manual interlock tests succeeded. User manual has been provided and can be considered as a good level of maturity for the acceptance.

Only a small subset of interlock tests have been included in this report. The interlock system was already tested and accepted on September 2016. Some missing tests have been successfully complete on this occasion as well. All result have been collected in an Excel file and attached to this report [5].

The control system of the source can be considered accepted by ESS. As remark it worth mention that the start-up command of the IOCs was not generated using the IOC Factory tool as recommended by ESS. This has not been considered an issue for the acceptance of the source since it doesn’t compromise the successful execution of the tests. It is planned to verify the proper use of the IOC Factory during the formal acceptance of the Control System for the LEBT part.

5. DEFINITIONS, ACRONYMS AND ABBREVIATIONS

Abbreviation	Explanation of abbreviation
ECR	Election Cyclotron Resonance
HV	High Voltage
ISrc	Ion Source
LEBT	Low Energy Beam Transport
PLC	Programmable Logic Controller

6. REFERENCES

[1] WeTest (wetest)
[2] Test scenarios (source-acceptance-tests)
[3] Report in pulsed mode (ESS-0121819)
[4] Report in continuous mode (ESS-0121819)
[5] PLC Acceptance Test Report (ESS-0121819)