

Direction des équipements sous pression nucléaires

Letter reference:

CODEP-DEP-2022-062690

EDF DI

The Director of the Industrial Division 2 rue Ampère 93206 Saint Denis Cedex 1

Dijon, 10 January 2023

Subject: Monitoring of outside contractors – Prevention, detection and addressing irregularities – Inspection of EDF DI concerning the addressing of irregularities at JSW INSNP-DEP-2022-1106 of 06 and 07 December 2022

Follow-up letter to the inspection of 6 and 7 December 2022 on the Prevention, detection and addressing of irregularities

File No.: Inspection No. INSNP-DEP-2022-1106

References: see appendix 1

For the attention of the Director,

As part of the mandate of ASN (*Autorité de sûreté nucléaire*), the French Nuclear Regulator, concerning the inspection of basic nuclear installations (BNI) stipulated in Article L. 592-22 of the Environment Code, a routine inspection of EDF was carried out on the 06 and 07 December 2022 relative to EDF's monitoring associated with the irregularities detected at the supplier Japan Steel Works (JSW) in Muroran (Japan).

I give you below the inspection summary and the resulting requests, findings and observations.

INSPECTION SUMMARY

On May 10 2022, EDF informed ASN that irregularities had been detected at Japan Steel Works (JSW) in its conventional industry sector. The irregularities detected at JWS concerned more specifically chemical analyses, mechanical test, non-destructive inspections and residual stress measurements. Nevertheless, and although the nuclear sector was not directly concerned, in order to guarantee the situation for products intended for the nuclear sector, EDF set up a *Task force* comprising the licensees EDF and Orano, and the manufacturers of level N1 nuclear pressure equipment (NPE)

(Framatome, Mitsubishi Heavy Industries, Westinghouse Electrique France) and General Electric, to conduct inspection investigations. EDF is the leader of this Task force.

EDF recorded the work and conclusions of the *Task force*, available on 30 September 2022 in the report reference[5]

By letter reference [7], ASN formulated several requests to the Task force and the manufacturers concerning the resuming of production at JSW, which had been stopped as a precautionary measure as soon as the detection of irregularities in the conventional sector was announced. To meet these requests, EDF sent ASN the letters references [8] and [9].

Alongside this, JSW mandated a special investigation committee (SIC), including third-party lawyers, tasked with conducting an in-depth internal investigation. On 14 November 2022, the JSW SIC issued a press release reporting the discovery of an extension of the irregularities to products in the nuclear sector.

The ASN inspection concerned the investigations carried out by EDF, the *Task force* leader, before this press release was issued. It was based in particular on the information figuring in reference documents [5], [8] and [9]. The inspection allowed the integration of a certain amount of new information obtained from JSW following their press statement announcing irregularities in the nuclear sector.

The ASN inspectors met JSW senior management at the head office in Tokyo, the JSW personnel of the Muroran site and representatives of EDF and the manufacturers Framatome and Mitsubishi Heavy Industries (MHI). Representatives of the Japanese nuclear regulation authority (NRA) and of the accredited organisations Bureau Veritas Exploitation and APAVE, also attended this inspection as observers.

The ASN inspectors examined the investigation methods deployed by the *Task* force and JSW during the first phase of investigation, the different cases of irregularities detected in the

nuclear sector and the progress of certain plans defined by JSW following detection of the irregularities in the conventional sector.

They noted the determination of the JSW representatives to address the detected problem exhaustively. To this end, the JSW representatives undertook to conduct a new phase of investigations in a climate of transparency, thereby enabling the *Task* force to perform its work in depth.

The inspectors observed that the investigation methods employed by EDF in phase 1 had not enabled the irregularities in the nuclear sector to be detected.

The inspectors therefore consider it necessary to revise the *Task force's* analysis methodology for the future investigations, more specifically by having guaranteed access to all the JSW documentation.

ASN expects EDF to ascertain that the JSW action plans for resuming production are robust and, if necessary, to adapt its contracting and monitoring methods.

Lastly, EDF must learn the lessons from these irregularities.

This inspection provided ASN with initial points of information concerning the irregularities detected in the nuclear sector and the associated causes. These irregularities concern more particularly non-destructive tests, destructive tests, dimensional checks and failure to carry out or to declare manufacturing operations. The handling of these deviations, currently being examined by JSW, was not analysed during this inspection. Only one case out of those affecting the French nuclear scope concerns an item of equipment in service. The item concerned is a steam generator nozzle support ring of reactor 1 of the Cruas nuclear power plant. After analysing the elements provided by JSW, separately from the inspection, EDF concludes that this irregularity does not affect the integrity of this equipment item.

ASN asks EDF to adopt a position regarding the impact if other irregularities that affect or could affect the equipment in service are identified. ASN also asks EDF to adopt a position regarding the impact of the irregularities on the conformity of the equipment currently in the manufacturing process with their manufacturing baseline requirements.

The following requests concern all the equipment items intended for the nuclear sector (NPE, safety-important components, packages, etc.). EDF will send the updates of the CFSI (Counterfeit, Fraudulent, Suspect Items) report incorporating the responses to the following requests and the schedule for these updates.

I. REQUESTS TO BE ADDRESSED IN PRIORITY

Not applicable

II. OTHER REQUESTS

Irregularities detected at JSW

Integration of lessons learned

Article 2.4.1 of the BNI order reference [4] stipulates:

"I. - The licensee defines and implements an integrated management system that ensures that the requirements relative to protection of the interests mentioned in Article L. 593-1 of the Environment Code are always taken into account in any decision concerning the installation."

III. - The integrated management system notably includes provisions enabling the licensee:

- to collect and use the experience feedback"

The inspectors examined the investigation methods used by the Task force, the SIC and JSW in phase 1¹¹. EDF pointed out that the technical documentation requested of JSW to conduct the investigations in phase 1 corresponded to the files relating to the conventional equipment concerned by the irregularities (reports, work records from the operators and source data). EDF pointed out that it had not had access to the preliminary investigations or the possibility of interchanging with JSW senior management located in TOKYO; the interchanges were limited to the Quality Assurance Group (QAG) of the Muroran site. The JSW representatives pointed out that they had responded strictly to the requests of the Task force, by sending only the requested documentation. Consequently, the Task force did not receive the Internal Communication Sheets (ICS) tracing the interchanges on the irregularities as the manufacturing operations proceeded.

With regard to experience feedback, it is pointed out that several cases of irregularities

¹ Phase 1 corresponds to the investigations conducted by the Task Force on the nuclear equipment files when the JSW SIC announced that it had detected irregularities on equipment in the conventional sector.

detected in the past with other suppliers from the nuclear sector had revealed the use of internal documents to formally record the handling of irregularities.

The inspectors therefore observed that EDF and the other Task force members had not asked themselves whether the irregularities might be recorded in JSW's internal documents. This led to a de facto limitation of the Task force's documentary scope of investigation.

Despite JSW's lack of transparency with the Task force during the investigations conducted from May to October 2022, notably through the failure to inform of the internal documentation tracing the irregularities, the inspectors considered that EDF and the NPE manufacturers, in their methods of conducting their investigations, had not taken into account the lessons learned from past irregularities.

Request II.1: The lessons learned in this respect must be taken into account in the EDF quality system and in particular in the methodological aspects of investigating irregularities.

Request II.2, as part of integrating the lessons from past experience, transmit the measures EDF plans using to assess whether the types of irregularities detected at JSW are found with other suppliers. Specify the calendar time frames for these actions.

Scope of the JSW sites concerned by the irregularities

EDF pointed out that JSW had three other manufacturing sites in addition to the Muroran site: Hiroshima, Yokohama, Meiki. JSW indicated that these sites did not manufacture constituent parts of equipment for the nuclear sector.

Request II.3: confirm that the other JSW sites are not involved in the manufacture of components or equipment for the nuclear sector.

Irregularities detected in the nuclear sector

<u>Defining the irregularities</u>

JSW senior management pointed out to the ASN inspectors that there had been numerous

interchanges between the SIC and the JSW personnel to define the criteria enabling the irregularities to be identified in an equipment file. The example of internal manufacturing operations was mentioned in particular. The JSW representatives stated that the criteria had been agreed upon and were used as the basis for deploying the investigation method.

Request II.4: In the CFSI report to be submitted by EDF, give a conclusion on the appropriateness of the irregularity criteria defined and adopted by JSW.

Identified cases and exhaustiveness

JSW presented to the ASN inspectors the deviations detected in the nuclear sector concerning the non-destructive tests, destructive tests, dimensional inspection and the failure to perform or declare manufacturing operations. Framatome, who attended the inspection, indicated that it has identified that other nuclear equipment items were impacted by the failure to perform or to declare manufacturing operations.

Further to the irregularities detected in the nuclear sector, EDF indicated that the Task force was going to carry out another examination of the equipment files, analysing in particular the internal communication sheets so that it could adopt a position regarding an exhaustive list of case types.

Request II.5: Adopt a position on the conformity of the in-service equipment affected or liable to be affected by irregularities, and on the ongoing contracts. Inform ASN without delay of newly detected cases of irregularities that could have an impact on the integrity of an item of equipment.

<u>Undeclared moulding operation</u>

An irregularity detected by the SIC concerned an undeclared forging operation (forging rework). This operation can have an impact on the characteristics of the part, mechanical in particular. The inspectors asked JSW about the recurrence of forging rework operations of this type during manufacture. For the EDF steam generator replacement contracts 4 to 6, the JSW Quality Department representative stated that this operation had only been

carried out once. The inspectors questioned the EDF representatives whether other forging suppliers practised this type of operation, in order to have a critical analysis of JSW's assertions. This information could not be provided during the meeting.

Request II.6: Characterise the risk of this deviation at JSW extending to other products.

Action plans and corrective action further to the detected irregularities

Safety culture, CFSI risk, integration of experience feedback by JSW

The *Task force* had defined several prerequisites for restarting nuclear pressure equipment (NPE) production, and notably the need for a reinforcement of the JSW personnel safety culture through a new training course and self-assessment based on the WANO principles. EDF stated in its letter reference [8] that this point was settled. The inspectors examined the JSW procedure concerning the safety culture approach which indicates that an initial self-assessment was carried out on 15 September 2022 followed by complementary training on the operators' weak points identified by this self-assessment, which ran until 15 December 2022. The JSW representatives indicated that the self-assessment phase was finalised but the complementary training had not yet been carried out. The inspectors considered that EDF had not adequately monitored the progress of the safety culture action plan defined by JSW.

Request II.7: Detail the causes behind this deviation, the corrective actions identified and the procedures defined by the Task force for monitoring current and future action plans at JSW.

Position of the Quality Assurance Group (QAG) department and JSW's new organisation

The irregularities detected in the nuclear sector highlighted the involvement of JSW's QAG Department in the irregularities. EDF pointed out that a new department named QMO (Quality Management Office) reporting to the JSW President in Tokyo had been created recently.

The aim of this new service is more specifically to establish the quality policy of the JSW group and supervise the quality departments situated on the different sites (quality recommendations, personnel training, dealing with irregularities), but also to conduct inspections on the JSW sites. The EDF representatives indicated that they were in direct contact with this new department for the future investigations concerning the nuclear equipment.

Request II.8: Transmit the Task force's analysis of the preventive and corrective actions (organisational changes, monitoring, additional provisions) defined by JSW following detection of the irregularities in the nuclear sector.

Detail the factors guaranteeing the independence of the QMO quality department on the Muroran site.

<u>Production monitoring feedback</u>

Article 2.5.4 of the order reference [4] states:

"I.- The licensee schedules and implements appropriate random verifications of the measures taken in application of articles 2.5.2 and 2.5.3, and carries out periodic assessments of their suitability and effectiveness.

II. ? When the protection important activities or their technical control are performed by outside contractors, the ensuing verifications and assessments constitute monitoring of the outside contractors, and the provisions of article 2.2.3 apply. "

The ASN inspectors observed that the monitoring methods applied by EDF and the manufacturers during the manufacturing operations at JSW did not detect the irregularities (untraced manufacturing operations, modifications of tests, etc.).

The irregularities detected in the nuclear sector highlight the need to monitor the internal documentation of the suppliers of EDF and of the manufacturers.

The inspectors also determined, through the elements presented by JSW, that:

- having the test pieces marked by a third party, ensuring that it is impossible to alter the test source data, and retrieving the test pieces, for example, limit the potential possibilities of committing irregularities,
- -for some singular parts, thick parts for example, there was a risk that the manufacturing

process would not always produce the required characteristics.

The inspectors therefore consider that the licensee's and manufacturers' monitoring procedures must take experience feedback into account in order, in the future, to limit the risks of committing irregularities and to be able to detect them, at JSW and other suppliers alike.

Request II.9: Adopt a position on the robustness of the JSW action plans for resuming manufacturing operations. If applicable, specify the changes made in the contracting and monitoring procedures to provide the necessary guarantees that no new irregularities will arise.

Investigation methodology of the Task force

EDF pointed out to the ASN inspectors that several investigation methodologies had been implemented by the *Task force* members in phase 1; some manufacturers based their analyses on JSW's investigations, while others conducted independent analyses. The inspectors noted that the investigation procedures established by the *Task force* were not all subject to strict quality assurance procedures. EDF mentioned that the investigations are considered to be an activity monitoring protection important activities (PIA) as defined in reference document [4]. In this context, the inspectors considered it necessary, prior to the further investigations conducted in phase 2²², for the *Task force* to have an investigation procedure established in compliance with strict quality assurance procedures.

Request II.10: Establish an investigation procedure that is subject to strict quality assurance procedures for the nuclear equipment scope.

EDF showed the ASN inspectors the various documents to which the JSW SIC had had access for its investigations. EDF pointed out in particular that it had asked JSW for access to the Internal Communication Sheets (ICS) which formalise the management of irregularities

² Phase 2 corresponds to the new investigations undertaken by the Task Force on the nuclear equipment files when the JSW SIC announced the finding of irregularities concerning equipment in the nuclear sector.

within JSW.

The ASN inspectors questioned the EDF representatives about the benefits of having access to other JSW documents that were analysed by the SIC in order to better understand the past processes at JSW that led to the irregularities and thereby define an appropriate investigation method and scope (internal rules, minutes of meetings, results of employee questionnaires, computerized data).

JSW gave the ASN inspectors some of the information transmitted by the SIC, and in particular the investigated data, the number of interviews conducted and the deviations observed in the nuclear sector. The representative of JWS senior management pointed out during this interchange that they had not obtained the detailed results from the SIC. The inspectors observed in particular that it had not been possible to confirm the examination period or the exhaustiveness of the files examined.

The members of JSW senior management informed the ASN inspectors, primarily on the basis of the interviews conducted, of a number of hypotheses relative to the time frame of the irregularities. They noted in particular, as from 2011, organisational and human problems, schedule constraints and a change in safety requirements. JSW explained in particular that these findings were temporally consistent with the detection of the first case of irregularity in the nuclear sector in 2013.

The inspectors considered it necessary for the new methodology for detecting irregularities defined by EDF and the *Task force* to take into consideration all the documentation and relevant information and enable conclusions to be drawn on:

- the facts and the causes of the irregularities,
- the time frame concerned,
- the different types of irregularities,
- the extent of the irregularities,
- the conformity of the equipment.
- the residual risk of non-characterised irregularities and, where applicable, the measures defined to provide the required guarantees (controls in presence of all parties, etc.)

The inspectors identified, among other things, the need for the *Task Force* to integrate the following specific points in its investigation method:

• the exhaustiveness of the files analysed for the nuclear sector (NPE, PICs, etc.) in relation with a justified time range;

• the examination method for detecting any welding facing operations following undeclared grinding operations;

• consideration of related operations contributing to operations conformity (e.g. calibration of ultrasound testing equipment, etc.);

• the analysis of files that do not contain all the available documentation (archive retention time expired, etc.)

Request II.11: Establish an investigation method that meets these various requirements.

Consultation of JSW data for the investigations

EDF informed the inspectors that JSW had undertaken to conserve the material from past manufacturing operations and all the internal data for the equipment (NPE, PICs) until the investigations were completed.

Request II.12: Specify, in the methodology requested previously, the procedures established for conserving the material and the type of documentation archived (hard copy data, electronic data) for the various nuclear equipment items (NPE, PICs, packages, etc.).

Data archiving

ASN letter reference [10] states:

"The licensee, the supplier and its subcontractors must therefore take measures to guarantee the availability of the data at all times and for a duration compatible with the various life cycle phases of a BNI. Restricting human intervention in the management of these data helps to reduce the risk of fraud. »

The inspectors examined the new archiving conditions for the technical documentation defined by the Task force in document reference [8] and the JSW procedures in references [11] and [12]. Following the detection of irregularities in the conventional sector, the Task force pointed out that the 20-year period for source data retention had been specified at JSW for the data relating to the manufacturers Framatome, Mitsubishi Heavy Industries and Westinghouse Electrique France. These data are saved on a computer server.

In view of experience in dealing with past irregularities that necessitated consultation of the internal documentation of certain suppliers more than 40 years after manufacture, the inspectors question the retention period adopted by the Task force. The inspectors also questioned your representatives on the retroactivity of this archiving for the data still available at JSW. No answers were given during the meeting.

Lastly, considering the new types of irregularities detected in the nuclear sectors, particularly in the internal documentation, the inspectors considered that the *Task force* needs to reexamine the list of documents to be archived at JSW.

Request II.13: With regard to the irregularities detected at JSW, clarify EDF's analysis of:

- the consistency of the defined 20-year period with the data integrity requirement figuring in the letter reference [10] indicating the need to guarantee availability of the data at all times and for a period compatible with the BNI life cycle phases;
- the transfer of data between the supplier, the manufacturer and the licensee;
- the conditions for archiving the data still available at JSW (types of documents archived, procedures for backing up on the JSW computer servers).

Feedback after the start of the phase 2 investigations

Request II.14: Plan for an interim review with ASN to present the feedback after applying the new investigation methodology to the first equipment files.

JSW investigation methodology

During phase 1 of the investigations, some members of the *Task Force* considered that, as JSW was required to review the manufacturing files, it must have an appropriate method. EDF set out the JSW investigation method in reference [6], relative to the scope of the manufacturer Framatome. EDF pointed out to the inspectors on the basis of the JSW analysis form presented during the inspection, that this methodology was effectively inappropriate for detecting the irregularities identified in the nuclear sector, such as the detection of untraced manufacturing operations. In relation to the types of irregularities detected in the nuclear sector, the inspectors considered that the investigation method implemented by JSW in phase

1 was inappropriate.

The EDF representatives stated that they were waiting for a new investigation procedure from JSW to be deployed on the basis of exhaustive manufacturing documents.

Request II.15: Confirm that the new JSW methodology established in compliance with strict quality assurance procedures, covers all the nuclear product manufacturing operations and type of nuclear equipment (NPE, PICs, transport packages, etc.).

Transmit the Task force's assessment of the robustness of this new JSW investigation technology.

Detail the methods of formalising the assessment actions and JSW's technical positioning on each of the analysed files.

Protection important activities (PIA)

The inspectors consulted some tracking documents linked to the replacement steam generators EDF 6 and the TP900MWE replacement elbows manufactured by MHI.

The manufacturer stated that the list of protection important activities (PIA) according to the order reference [4] had been defined in relation with the EDF requirement reference EDMSN130127 rev A and the Guide RM 18 019 rev A of 14/05/2019. The EDF representative pointed out to the inspector that the list of PIAs and technical controls (CT) had been approved by EDF.

The inspectors observed that the welding operations were defined as PIAs but with no technical controls recorded on the manufacturing tracking document. It was pointed out more particularly that the welding technical controls were the pre-welding (fit-up) and post-welding operations (NDT in particular).

The inspectors noted that the list of PIAs adopted for these projects differed from the list established by EDF for certain manufacturing operations on the Flamanville EPR project (VVP - main steam system - welds) and referenced in EDF document reference [13], such as the activities of marking, taking tests specimens or mechanical tests which are not defined as PIAs. Furthermore, some welding operation technical controls are defined in reference document [13] whereas these controls are not mentioned in the MHI manufacturing tracking

document.

Lastly, further to the first analysis of the irregularities in the nuclear sector detected at JSW, a risk of irregularities during the marking of test coupons and specimens was evidenced, particularly when there was no monitoring. The inspectors thus considered, in addition to the consistency with the abovementioned memo reference [13], that EDF should reflect upon the classification of this activity.

Request II.16: Send a table, like the one in memo reference [13] for the Flamanville EPR project, listing the PIAs and technical controls adopted for the ongoing projects. Detail and justify the identified differences in approach.

III. FINDINGS OR OBSERVATIONS NOT REQUIRING A RESPONSE FROM ASN

Action plans and corrective actions further to the detection of irregularities

Personnel interviews

The ASN inspectors conducted several personnel interviews in order to understand the issuing process for internal communication sheets (ICS), the context for issuing them and the lessons learned from the irregularities detected. The people interviewed have satisfactory knowledge of the types of irregularities encountered and were aware of the seriousness of the acts.

The inspectors nevertheless observed that the forging engineer interviewed did not know about the irregularity detected on the forging operations of a nuclear equipment item.

Observation III.1: Ascertain that the measures applied by JSW enable all the JSW personnel to benefit from the lessons learned from the detected irregularities.

QAG Monitoring

The inspectors examined the elements provided by the Task force concerning the new

monitoring methods of the QAG entity of JSW, defined following the detection of irregularities in the conventional sector. The JSW documentation examined indicates in particular the role of the quality engineers regarding the comparison of raw data.

In relation with the new types of irregularities detected in the nuclear sectors, the inspectors reflected on the additional monitoring measures implemented by JWS to guarantee the detection of irregular internal documents, as well as any internal nonconformities that were not subject to the opening of a nonconformity report.

The JSW representatives stated that their objective was to create a data retention system without human intervention to limit the risks of irregularities being committed. The inspectors consider it necessary, until the new tool is available, for the Task force to detail the complementary monitoring actions defined by JSW for detecting any future irregularities.

Observation III.2: Ascertain that the complementary monitoring actions defined by JSW will detect potential future irregularities, particularly through the supplier's internal documentation.

Process relating to the quality events at JSW

The EDF representatives told the ASN inspectors that at this stage, all the irregularities detected were traced through the issuing of an internal communication sheet (ICS). JSW presented the newly revised quality management system, specifying that from now on, no documents other than those mentioned in the quality manual could be used; this means that the JSW personnel cannot use the ICS's.

Observation III.3: Ascertain that the new procedures adopted by JSW for internal communications between services cannot be used to formalise irregular practices.

JWS investigation methodology

The phase 1 investigations led that Task force to highlight the Quality Assurance Group (QAG) department as the main organisational entity constituting a strong defence against the risk of irregularities in the nuclear sector. The elements presented by JSW showed that this

department was involved in all the cases of irregularities detected in the nuclear sector.

JSW's current method provides for an examination of the equipment files by QAG, which is

itself implicated in the detected CFSIs.

Observation III.4: Ascertain that the parties involved in the investigation are impartial in

their handling of the cases.

*

I would therefore ask you to communicate to me within two months, using the transmission

methods indicated below, your remarks and observations and the measures you will take to

remedy the above findings and respond to the requests. As regards any commitments you

might make, I would ask you to identify them clearly and indicate a date of accomplishment

for each one.

I would moreover remind you that it is your responsibility to address all the findings made

by the inspectors, including those which have not formed the subject of formal requests.

Lastly, in accordance with the transparency and public information initiative instituted by

the provisions of Article L. 125-13 of the Environment Code, I inform you that this letter will

be posted on line on the ASN website (www.asn.fr).

Yours sincerely,

The Director of ASN/DEP,

Signed by

Corinne SILVESTRI

Appendix 1 to CODEP-DEP-2022-062690: List of references

- [1] Environment Code, and its Article L. 592-22 in particular
- [2] Environment Code, and more specifically chapter VI of title IX of book V;
- [3] Environment Code, and more specifically chapter VII of title V of book V
- [4] Order of 7 February 2012 setting the general rules concerning basic nuclear installations
- [5] D309522034387 rev. A of 30 September 2022 Summary notice of the CFSI risk analysis at the supplier Japan Steel Works concerning the orders for EDF French nuclear fleet
- [6] JSW Procedure 22-QTCS-03 rev.0
- [7] CODEP-DEP-2022-044752 of 28 September 2022- JSW irregularities ASN prerequisites for restarting procurements of level N1 NPE components
- [8] EDF letter D309522038972 of 10 November 2022 responses to points 1 to 5 of letter CODEP-DEP-2022-044752 of 28 September 2022
- [9] EDF letter D309522345169 of 14 October 2022: responses to point 6 of letter CODEP-DEP-2022-044752 of 28 September 2022
- [10] ASN letter CODEP-DEU-2018-021313 of 15 May 2018: Measures relative to the prevention, detection and dealing with irregularities (fraud)
- [11] JSW procedure NQ 10003 AD1
- [12] JWS Procedure CSP DC 15039
- [13] EDF document D458518038750: Conformity assessment of the CPP-CSP assembly