PEACE

D3.1 Stack components

Action Acronym: PEACE

Action title: Project 101101343 - Pressurized Efficient Alkaline Electrolyser

Author: Francesca Frulla , Paolo Lupotto

Contributing authors: All project partners

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SEN	Sensitive	

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PEACE Consortium

Beneficiary name	Short name
Deutsches Zentrum für Luft- und Raumfahrt e.V. (DE)	DLR
Materials Mates Italia SRL (IT)	MMI
Technische Universiteit Eindhoven (NL)	TU/e
Brandenburgische Technische Universität Cottbus Senftenberg (DE)	BTU CS
Grant Garant sro (CZ)	GG
HyCC B.V. (NL)	HYCC B.V.
Danmarks Tekniske Universitet (DK)	DTU

List of abbreviations

Abbreviation	Definition
AEL	Alkaline electrolysis
CC	Creative Commons Attribution International Public Licence
CC0	Creative Commons Public Domain Dedication
CFD	Computational Fluid Dynamic
DMP	Data Management Plan
EB	Executive Board
FEA	Finite Element Analysis
FMEA	Failure Mode and Effects Analysis
HAZOP	Hazard and Operability Analysis
LCA	Life Cycle Assessment
M	Month
PEDR	Plan for the Exploitation and Dissemination of Results
PM	Person-month
WP	Work package

Table of contents

1. Executive Summary

PEACE is a research and innovation action project financed by the Clean Hydrogen Partnership under the Horizon Europe. Its main objective is to reduce the levelized cost of hydrogen via development of an innovative high-pressure alkaline electrolysis technology for hydrogen production. The potential for obtaining the excellent performance of the pressurized PEACE electrolyser lies in the stack and system design and modification. These are the key components, which need to be designed, refurbished and developed and the overall project strategy is based on that. The duration of the project is 36 months. A total of six work packages (WP) are defined for this project. The packages are covering any aspect of the production, use, maintenance of a plant based on the proposed technologies, as well as the highlight of the strategic placing of it as industrial product for the decarbonization of chemical processes. To derive and guide the research and development, very detailed WPs are defined for describing the requirement, approaches and targets. A detailed work package is also allotted for project management and coordination (WP1) and for circularity, dissemination, exploitation and development of business cases activities (WP6).

2. Project Summary

The PEACE project represents a challenging research and innovation action in the field of hydrogen production, using the alkaline electrolysis (AEL) technologies. AEL technologies are known for their low investment costs and excellent scalability. The PEACE project aims to further improve the levelized cost of hydrogen produced by AEL. Therefore, efforts are focused on enhancing efficiency, maximizing current densities, and enabling better integration with downstream processes. By carefully designing a high-pressure stack and system, the performance and overall efficiency of the AEL process will be significantly improved, eliminating the need for additional compression for downstream processes. This, in turn, reduces the capital and operational expenses associated with hydrogen compressors, which are a substantial part of electrolysis systems' cost.

Within the PEACE project, a demonstrator of an AEL system exceeding 50 kW, capable of operating at pressures of up to 90 bars, will be designed and developed. This is achieved through a novel concept involving two-stage pressurization: by applying up to 60 bar hydraulic pressure using a pressure vessel in which a stack operates at additional 30 bar, resulting in up to 90 bar gas pressure. The integration of advanced components, innovative design, and optimized operation strategies will be explored through modelling and experimental testing, ultimately aiming to demonstrate a system with impressive efficiency characteristics: 70% lower heating value at a current density of 1 A/cm^2. The successful implementation of this technology promises a significant reduction in the cost of green hydrogen production.

The PEACE project scientific objectives are reinforced by a strong focus on sustainability and circularity aspects, as well as dedicated outreach activities. The consortium comprises two SMEs, four research and development centres with established expertise in alkaline stack, system, and Life Cycle Assessment (LCA), and one of the largest hydrogen production and utilization companies globally. This collaboration ensures a comprehensive approach to achieving the project's goals.

Finally, the project aims to propose use cases and the concept of an integrated plant. By combining all these developments, the goal is to achieve a technological breakthrough with a clear commercial perspective, positioning Europe as a leader in highly pressurized AEL technology within the next three years.

3. **WP Name** : STACK COMPONENTS FOR HIGHLY PRESSURIZED AEL

3.1. Objectives

We are focused on the development of stack components and assembly of a short stack capable of operating at 30 bar overpressures. This stack will be specifically designed to ensure seamless integration within a pressure vessel, meaning the required performance and safety standard.

• Design of the stack with industrial standard sealing elements.

• Qualification of the use of low-cost plastic resins for the insulation parts.

• Qualification of pressure equalizing end plates.

• Integration of the high-performance electrodes supplied by DLR with the elastic element

• Improvement of existing design to be able to lower the stack's cost.

• Implementation of a short stack first and a full-stack later and integration with the pressurized test rig supplied by BTU

Discussion and qualification of all technologies used in the different parts performed by MMI, DLR, BTU. Tests will be carried out at 80 °C, but also assessed at higher temperatures.

3.2. Tasks and subtasks Deliverable D3.1

Task	Sub-task	HARMOGRAM	*PREDEC.*	*SUCCESSORS*	*START*	*FINISH*
T3.1		Scaling up, procurement and supply of cell components for press. stack (M1-M24)				
	T3.1.1	Identification of stack components and key production's technologies needed		*T3.1.2*	*Jun-23*	*Sep-23*
	T3.1.2	Suppliers/materials evaluation and grading	*T3.1.1*	*T3.2.3*	*Sep-23*	*Oct-23*
	T3.1.3	Purchase of dedicated CNC systems		*T3.1.4*	*Sep-23*	*Dec-23*
	T3.1.4	Start of production of single cell cells components	*T3.2.2*	*T3.2.3*	*Jan-24*	*Mar-24*
	T3.1.5	Production of stack components not needing optimization	*T3.2.2*	*T3.2.5*	*Mar-24*	*Jun-24*
	T3.1.6	Production of parts with optimized design	*T3.2.4*	*D3.1 , T3.3.1*	*Jun-24*	*Dec-24*
	T3.1.7	Production of parts with optimized design (optional)	*T3.1.6*	*D3.1 , T3.4.3*	*Dec-24*	*Jun-25*
T3.2		Design of improved stack components for pressure operation in the stack (M1-M18)				
	T3.2.1	Design of optimized cell for short-long stacks		*T3.2.2*	*Jun-23*	*Nov-23*
	T3.2.2	Validation of the design by FEA on thermal/flow	*T3.2.1*	*T3.1.4*	*Nov-23*	*Feb-24*
	T3.2.3	Construction of single cell test rig	*T3.1.4*	*T3.2.4*	*Feb-24*	*Mar-24*
	T3.2.4	Test of single cell test rig	*T3.2.3*	*T3.2.5*	*Mar-24*	*Jul-24*
	T3.2.5	Test evaluation and eventual re-design of parts	*T3.2.4*	*T3.2.6, T3.1.6*	*Jul-24*	*Oct-24*
	T3.2.6	Final design of stack parts	*T3.2.5*	*T3.1.5*	*Oct-24*	*Dec-24*

3.2.1 Task 3.1 Scaling up, procurement and supply of cell components for press. stack (M1-M24): objectives

The first part of the activity is dedicated to the identification of proper materials and technologies for the stack production, with a specific focus on the industrial application of the solutions of choice.

The adoption of scalable tools and widely available standard materials in the market is intended to lower the stack's cost, encompassing both its components and workload.

The development of a cell, initially designed for laboratory use and material evaluation, and subsequently scaled to a life-size model, serves as a benchmark for the decisions made, providing opportunities for improvements and optimizations prior to the implementation of the full-size stack.

The objective is then to set-up of a complete production process on small scale capable of routinely build cells and stacks, optimized for the low-cost materials.

3.2.2 Task 3.1 Scaling up, procurement and supply of cell components for press. stack (M1-M24): results

The results of this task are divided into the following parts: tools, plastics, elastomers, bipolar plates + elastic elements, production techniques.

- **Tools**

  The construction of a stack is divided in different actions to be taken on the parts. The metallic end plates need to be manufactured in an agile process that allows quick and not-expensive changes: for this purpose, CNC mills are considered a top choice for thick parts, allowing not only the cutting in shape, but also some additional details execution, like threads, grooves and other details.

  On thinner parts, like bipolar plates and one possible elastic element style, laser cut flatbed plotters are considered the right choice for production. The same style of flatbed is useful for plastic milling, being the induced forces reduced to a minimum value.

  We bought for the purpose a flatbed CNC gantry mill, capable of mounting a laser head and a spindle at the same time to cover both uses.

  Elastomers can be placed using two main ideas:

  Formed in place: a foam deposition then cured that forms a seal adhering one of the two sides.

  The nozzle for the deposit is compatible with the gantry mill, so it can be used for this purpose too.

  Cut to shape: using the CNC with rotating blade to cut the gasket to needed shape

  Pros and Cons was analysed: for the first samples the second option was chosen, continuing the investigation for the available compounds of the former in place suitable for the purpose.

- **Plastics**

We considered two types of plastics materials. The following table shows the main characteristics of the materials considered.

Plastic material	Maximum operating temperature long term	Tensile stress	Chemical compatibility	Notes
POM-C	100 °C	50 MPa – 80 MPa (63 Pa)	Yes	• Good performance • Low cost
PEEK	250 °C	90 MPa -170 MPa (97 Pa)	Yes	• Best performance • Expensive

The tensile stresses reported are those at room temperature. A range has been provided for both materials because this varies depending on how the material has been treated. The value in brackets is the average value. If, as in our case, we operate at ~80 °C, the tensile stress decreases and in particular for POM-C it is ~40-50 Mpa (from: Fahmi Bedoui, Bruno Fayolle. POM Mechanical Properties. Polyoxymethylene Handbook: Structure, Properties, Applications and their Nanocomposites (Polymer Science and Plastics Engineering), Wiley; Scrivener, pp.241-255, 2014, 978-1-118-38511-1. ff10.1002/9781118914458.ch9ff. ffhal-02798595) and for PEEK it is ~90 MPa.

To evaluate the resistance of plastic materials in our specific case, we conducted FEA simulations. We analyzed the stress on the materials by simulating compression up to 50 bar. The following table shows the maximum displacement and stress values obtained by applying a pressure of 50 bar for both materials considering a spacer of 5 mm.

Plastic material	Max disp (mm)	Max stress (Mpa)
POM-C	0.4982	35.10
PEEK	0.4160	33.18

From these evaluations, it is clear that both materials are suitable but if the safety ranges are considered, the POM-C is close to the limit values. In the next sections further simulations will be presented to understand which is the best plastic material to use for our purpose.

Regarding the choices, the results in the simulations shown a good safety margin respect to the maximum performances of the materials, however a cross check on safety margin rules withthe other partners is expected before the implementation in real parts.

- **Elastomers**

  We considered different types of elastomers. The following table shows the main characteristics of the materials considered.

Elastomer	Maximum operating temperature	Tensile stress	Chemical compatibility	Notes
EPDM	120 °C	5 MPa – 10 MPa	Yes	• Good overall performance and compatibility • Best sealing
PTFE	260 °C	15 MPa – 35 MPa	Yes	• Optimum performances and compatibility • Low sealing properties • Cold flow effect

  For our purpose, EPDM proves to be the most appropriate material to use.

- **Bipolar plates and elastic elements**

  The bipolar plates were considered cut from a sheet of SS316 L.

  1) For the elastic elements two options are considered: Knitted mesh, eventually waved to increase the volume, just placed between the bipolar plate and the electrode.
     This mesh can be realized in pure nickel, to avoid corrosion, or SS316L for harder elastic constant

  2) Formed metallic plate obtained from a SS316L sheet or a pure nickel sheet, cut with laser or electrochemical process, soldered to both electrode and bipolar plate.

  The choice between these two options is determined by different factors: cost, ease of mounting, overall performance.

  While the soldered parts are offering lower electrical resistance and a good predictability in terms of performances, the mesh insertion is a simpler and effective solution, affected by the overall mechanical pressure that will determine the performances in terms of effective “zero gap” performances.

  Both solutions will be validated by tests.

- **Production techniques**

  After the analysis performed and the simulation on the materials as part of task T3.2, here are the short resume of the production techniques:

- Plastic parts (spacers): milling with gantry mill at high spindle speed for one-pass surface quality
- Bipolar plates: preparation, laser cut /deburring / smoothing, spot welding of elastic elements/ electrodes
- End plates: milling by external producer/ passivating treatment
- Gaskets: preformed o-rings, punch-cut flat gaskets
- Other details: standard mechanical workshop activity, performed in-house

3.2.3 Task 3.2 Design of improved stack components for pressure operation in the stack (M1-M18): objectives

The second part of the activity, interleaved with T3.1, is about the physical form of the stack. The project is based on the availability of a pressurized vessel at BTU premises: the closing cover of the vessel will be the mounting base for the pressurized stack, being already provided with gas-tight current- and signals feedthroughs, and the fluidic connections to the stack.
The objectives of this part is to adapt the stack design to existing mounting constraints, to verify from a mechanical and fluidic point of view the possible performances and make the stack compliant with the PEACE project objectives in terms of power applied and pressure standing.

In the same process, a 25 cm^2 cell has to be developed to test the electrical and chemical behaviour of the components and distributed to the partners for standardization of the measurements.

The parts realized have to be tested for pressure standing at operating point at least to 30 bar

3.2.4 Task 3.2 Design of improved stack components for pressure operation in the stack (M1-M18): results

3.2.4.1 SubTask T3.2.1 Design of an optimized cell for short/long stacks

The method followed is the iterative interaction between the CAD design and the FEA results to an optimized drawing ready for the life-size test.

The pressure vessel limitations are inserted in the choice of the cell membrane shape, with a specific focus on the readability of the tests results in terms of performances vs process parameters.
This leads us to a rectangular shape with an aspect ratio close to 3:1 to reduce fluidic inhomogeneity on the majority of the surface.

The stack specs of 50 kW / 30 Bar differential pressure @ 1 A cm^2 / 1.8 V translate in the following operating conditions:

- Overall active area 1730 cm^2 x 20 cells = 3.46 m^2
- I/ V stack at nominal working point: 1389 A / 36 V
- Current density (defined by project) 0.803 A/cm^2 (note: parameter to give space to experiments on shorter stacks)

- Expected efficiency: 70 %
- Water recirculation needs: < 80 lt (over more than 2:1 min-max pressure range)
- KOH flow velocity in the cell: for 5 mm spacers: 1.07 m/s

The first design that you see in the drawings (Figure 2.1-2.4): is responding to different quality points for the use in an alkaline electrolyser:

- Rectangular shape for homogeneous flow of the lye
- Simple, symmetrical design of the spacers to standardize the production and reduce possible mistakes during the montage of the stack
- High length vs section of the connections to the input manifold to keep the undue electrical shorts low and improve the faradic efficiency.
  In the output path, the presence of bubbles is requiring less stringent path features, even if an evaluation to improve the faradic efficiency on that side too will be performed.
- The stack formation does not require specific tooling and is quite obvious in its realization.
  Note that the assembly design is reporting flat gaskets between the parts, as first draft.
  Tests on o-ring based gaskets are performed on the single cell test rigs before transfer them to this design

Endplates

Figure 2.1: Endplates.

Cathodic side spacer

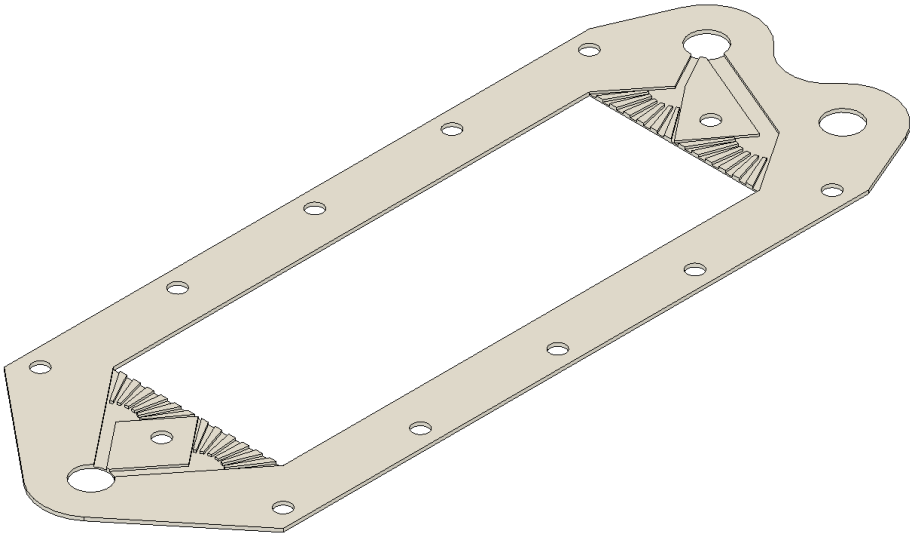

Figure2.2: Cathodic side spacer.

Anodic side spacer

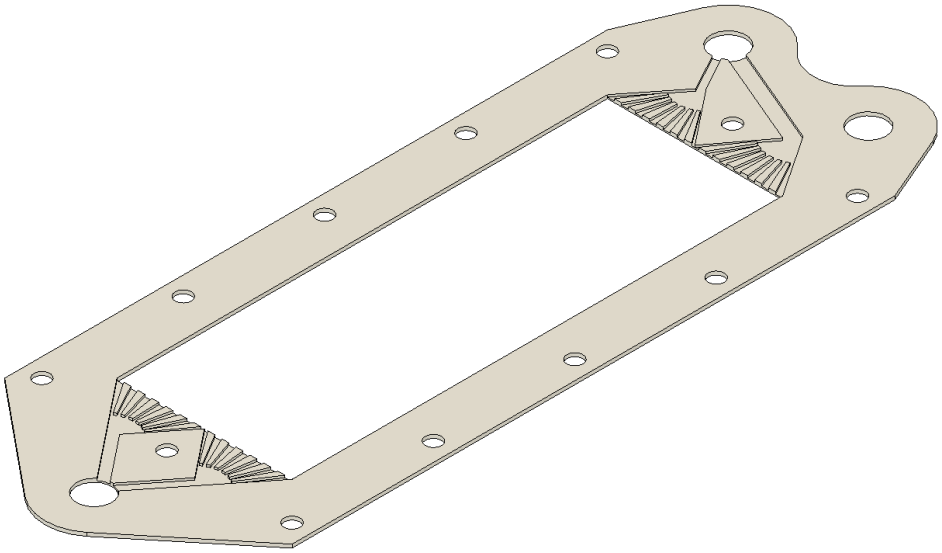

Figure 2.3: Anodic side spacer.

Stack formation

Figure 2.4 shows the stack formation with the proposed first design of the components. In this figure the membrane and the sealing design were not included.

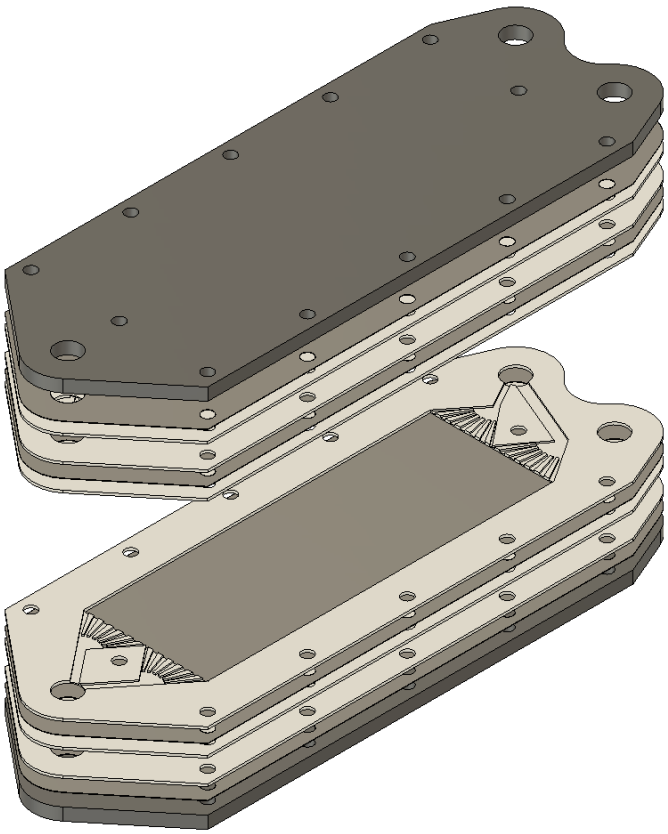

Figure 2.4: Stack formation.

This design of this first cell component was improved through FEA and CFD simulations.

3.2.4.2 SubTask T3.2.2 validation of the design by FEA on mechanical /flow

To design the optimized cell for the short-long stacks we made FEA simulations on the compression resistance of the stack components and CFD simulations on the fluid dynamics of the cell.

FEA simulations

The FEA simulations were made on the spacer, on the bipolar plates and on the endplates. We are using the compression bars in junction with the bipolar plates to stand the force expressed on the sides of the stack.

From the simulations, we saw the need to increase the bars' number in the cell so as to obtain less stress on the bipolar plates.

The stress on the endplates was considered and we decided to add reinforcement square sections on the latter. The following figures show the displacements and stresses that occur

in the spacer (PEEK 5 mm and POM 5 mm before and after adding the bars), in the bipolar plates (steel 316L 1 mm and 2 mm before adding bars) and in the endplates (steel 316L 25 mm) by applying a pressure of 50 bar or 30 bar.

Spacer PEEK 5 mm P=50bar before increasing the number of bars

Figure 2.5 and Figure 2.6 show respectively the displacement and stress that occur in the PEEK spacer after applying a pressure of 50 bar. These simulations were done considering an initial cell design in which there are five bars on the long side of the cell.

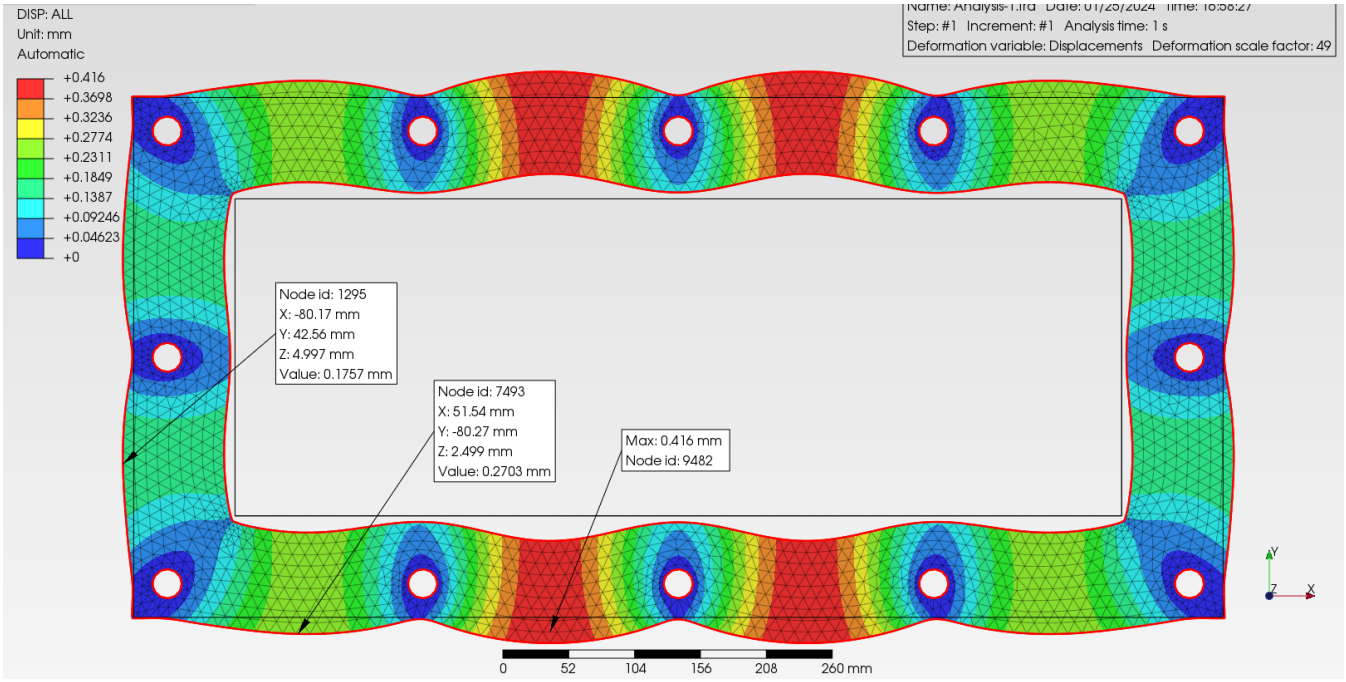

Figure 2.5: Simulation of the displacement that occurs in the PEEK spacer by appling a pressure of 50 bar.

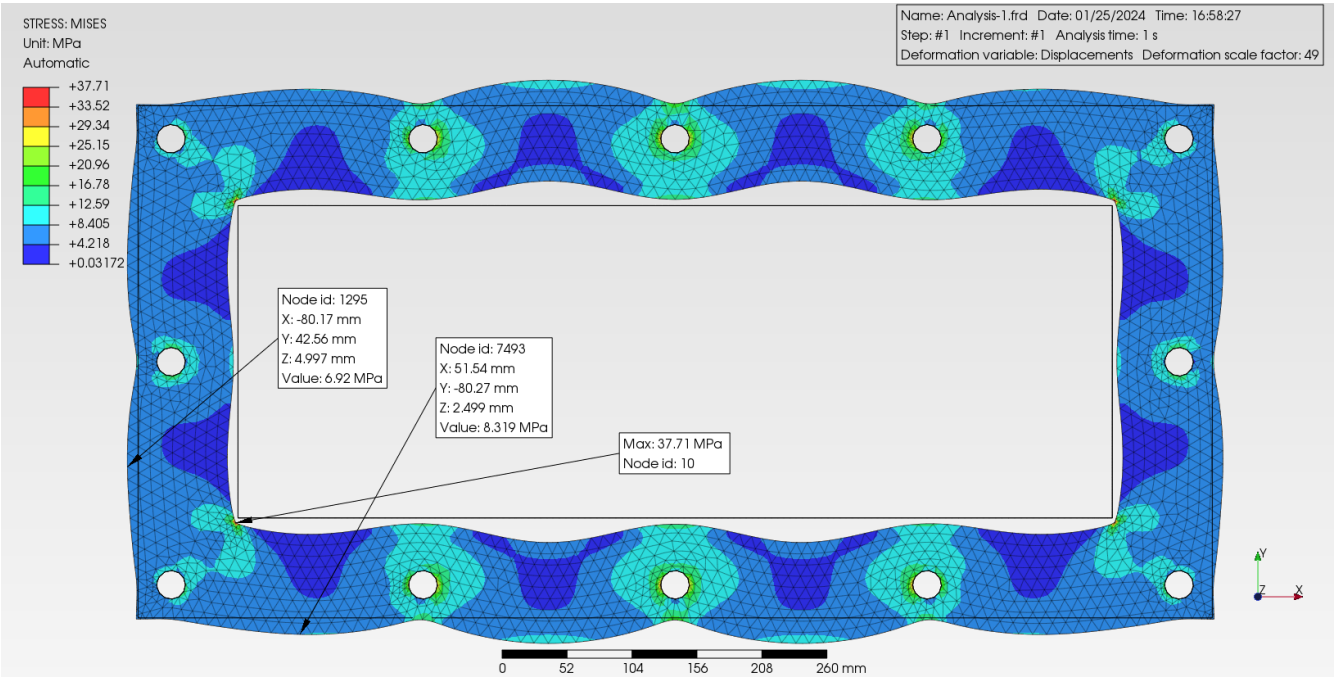

Figure 2.6: Simulation of the stress that occurs in the PEEK spacer by appling a pressure of 50 bar.

Spacer PEEK 5 mm P=50bar after increasing the number of bars

In order to reduce and to make more homogeneous the displacement and stress on the long side of the cell, we repeated the simulations with a new design. In this design two bars were added on the long side of the cell. Figure 2.7 and Figure 2.8 show respectively the displacement and stress that occur in the PEEK spacer after applying a pressure of 50 bar.

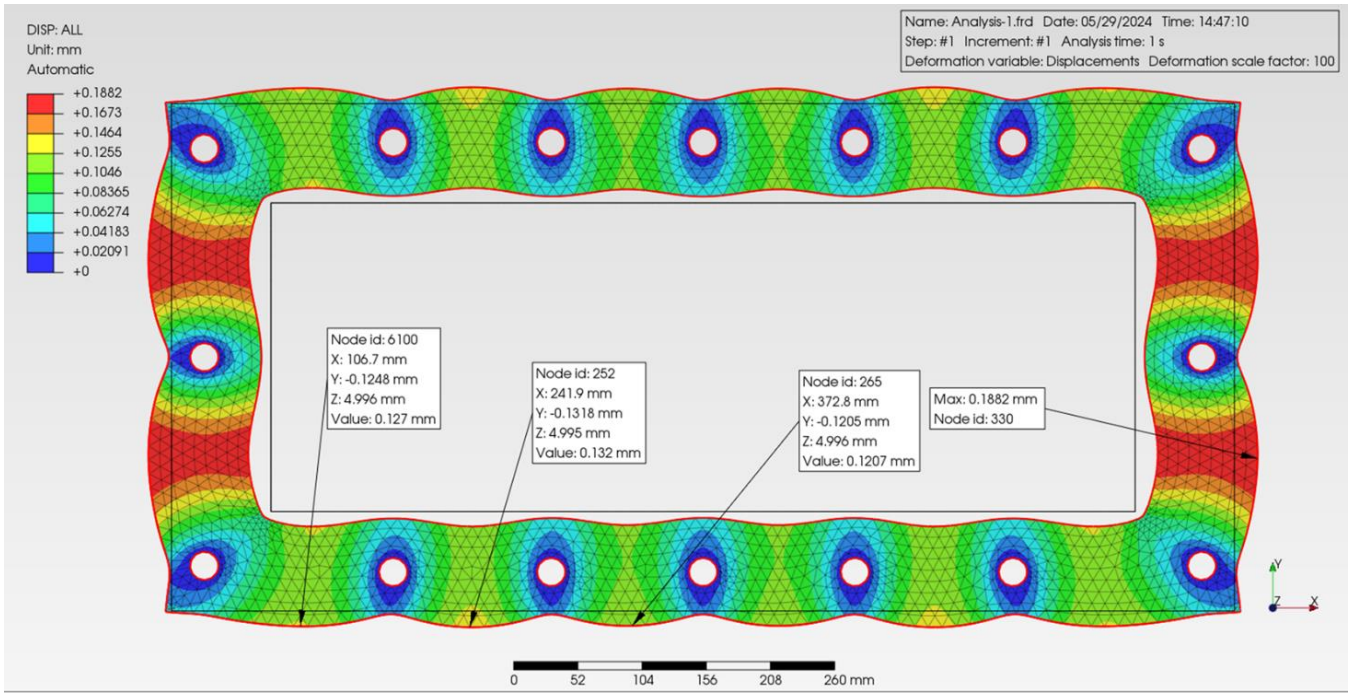

Figure 2.7: Simulation of the displacement that occurs in the PEEK spacer by appling a pressure of 50 bar.

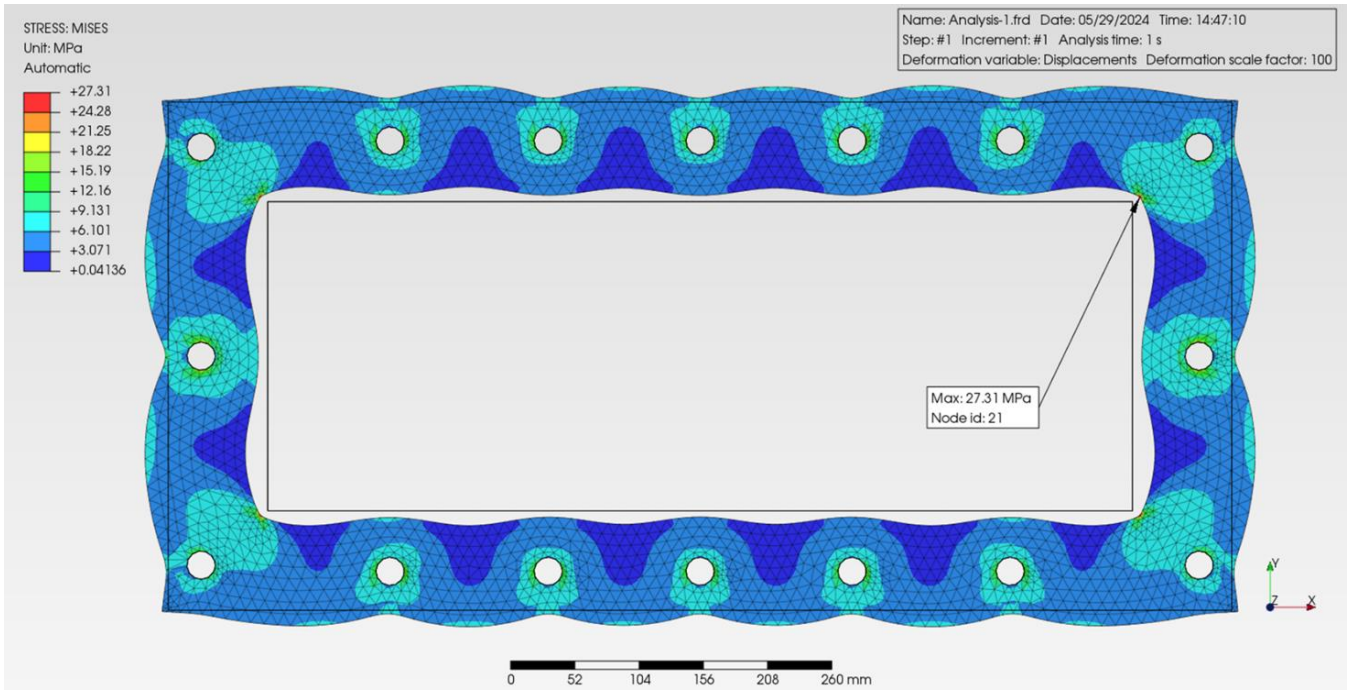

Figure 2.8: Simulation of the stress that occurs in the PEEK spacer by appling a pressure of 50 bar.

Spacer POM-C 5 mm P=50bar before increasing the number of bars

The same simulations were made considering the POM-C spacer. Figure 2.9 and Figure 2.10 show respectively the displacement and stress that occur in the POM-C spacer after applying a pressure of 50 bar. These simulations were done considering an initial cell design in which there are five bars on the long side of the cell.

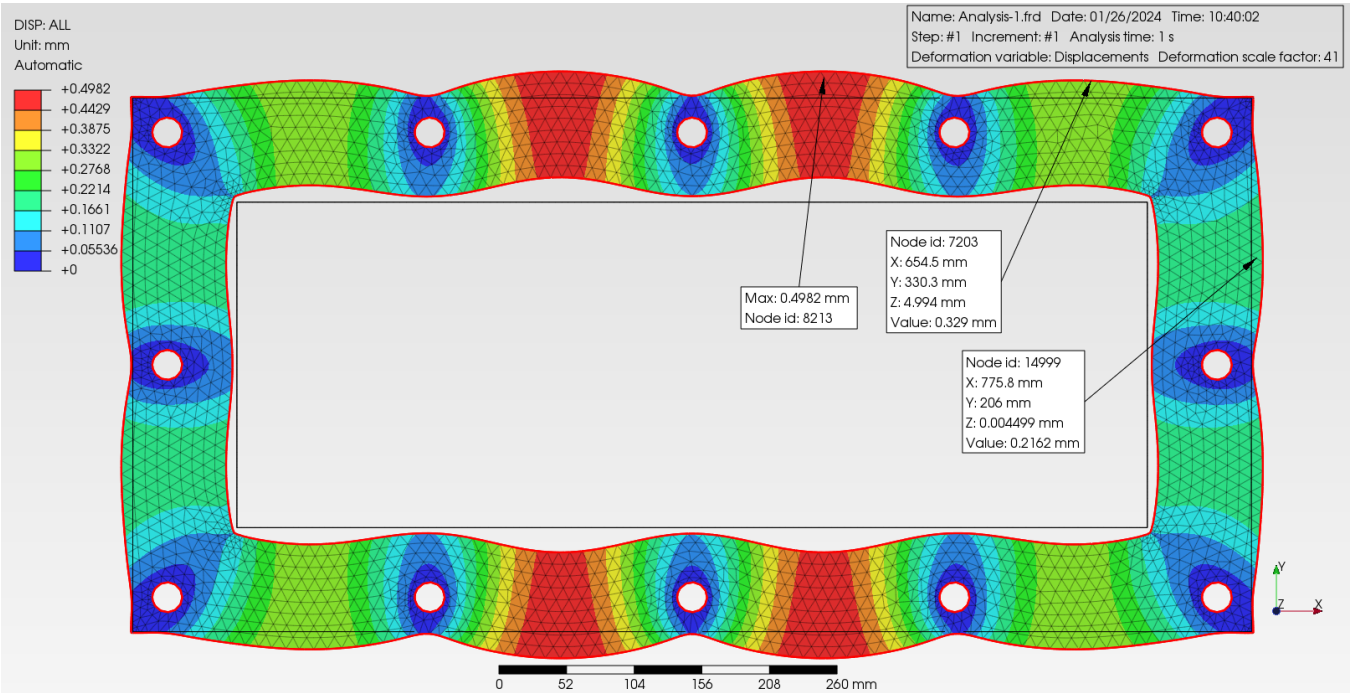

Figure 2.9: Simulation of the displacement that occurs in the POM-C spacer by appling a pressure of 50 bar.

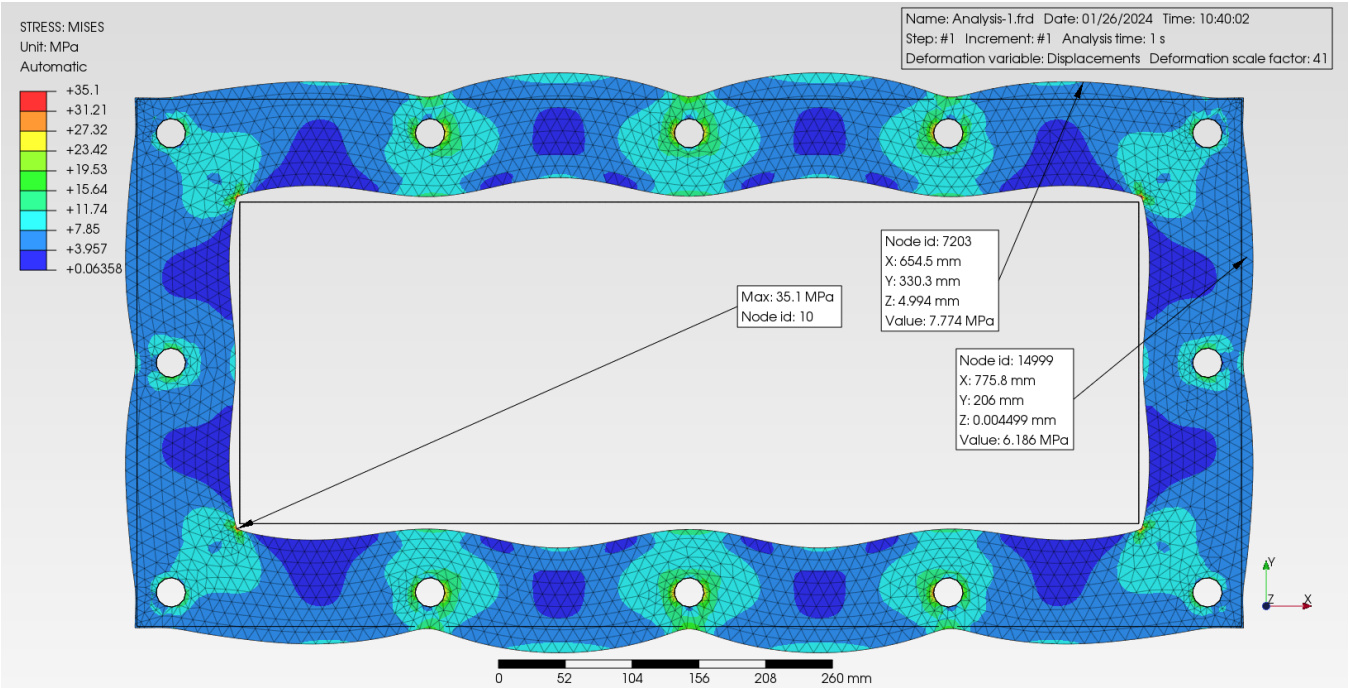

Figure 2.10: Simulation of the stress that occurs in the POM-C spacer by appling a pressure of 50 bar.

Spacer POM-C 5 mm P=50bar after increasing the number of bars

In order to reduce and to make more homogeneous the displacement and stress on the long side of the cell, we repeated the simulations with the already explained new design. Figure 2.11 and Figure 2.12 show respectively the displacement and stress that occur in the POM-C spacer after applying a pressure of 50 bar.

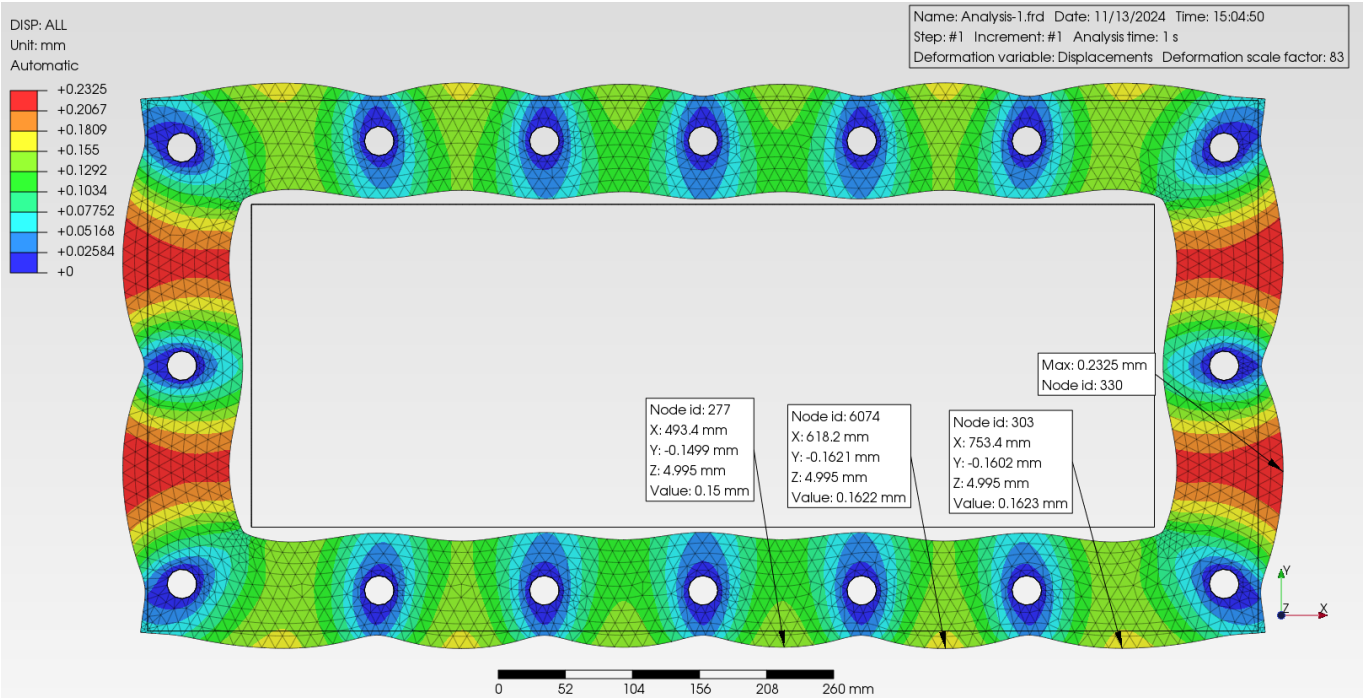

Figure 2.11: Simulation of the displacement that occurs in the POM-C spacer by appling a pressure of 50 bar.

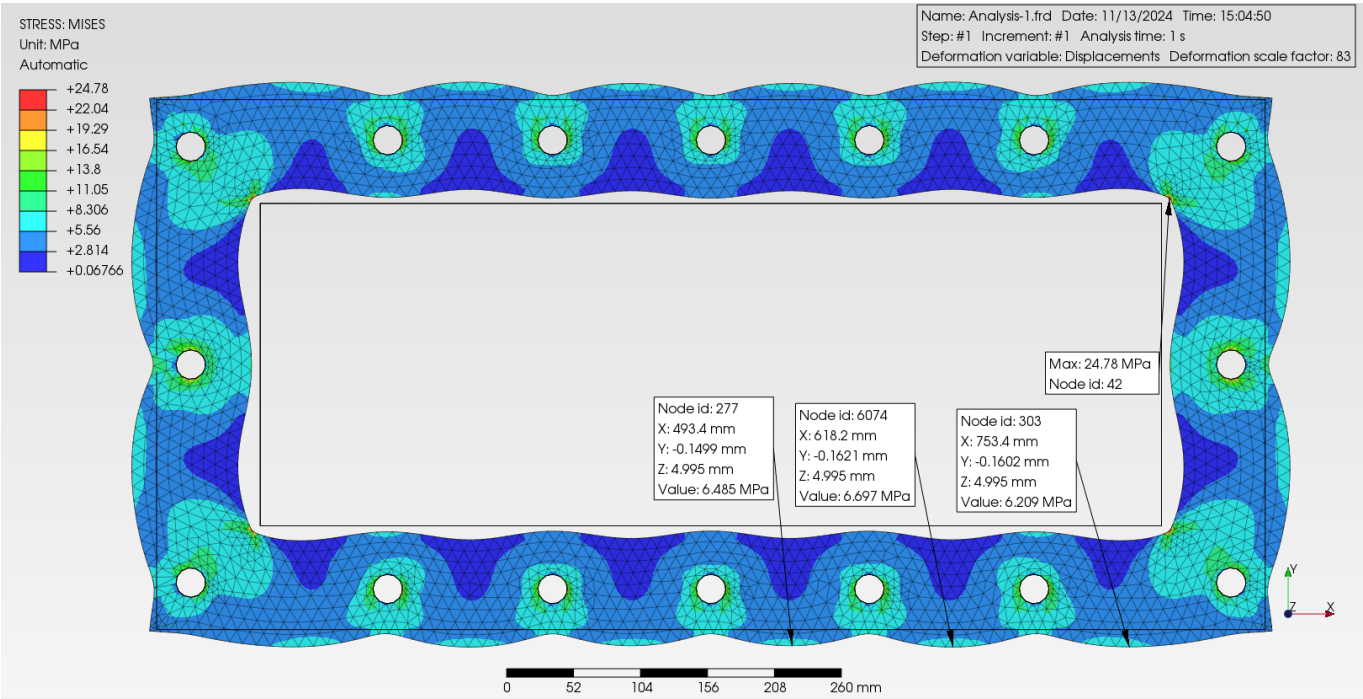

Figure 2.12: Simulation of the stress that occurs in the POM-C spacer by appling a pressure of 50 bar.

Bipolar steel 316L 1 mm P=30 bar before adding the reinforcement bars

Figure 2.13 and Figure 2.14 show respectively the displacement and stress that occur in the 1 mm thick bipolar plate after applying a pressure of 30 bar. These simulations were done considering the initial cell design in which there are five bars on the long side of the cell.

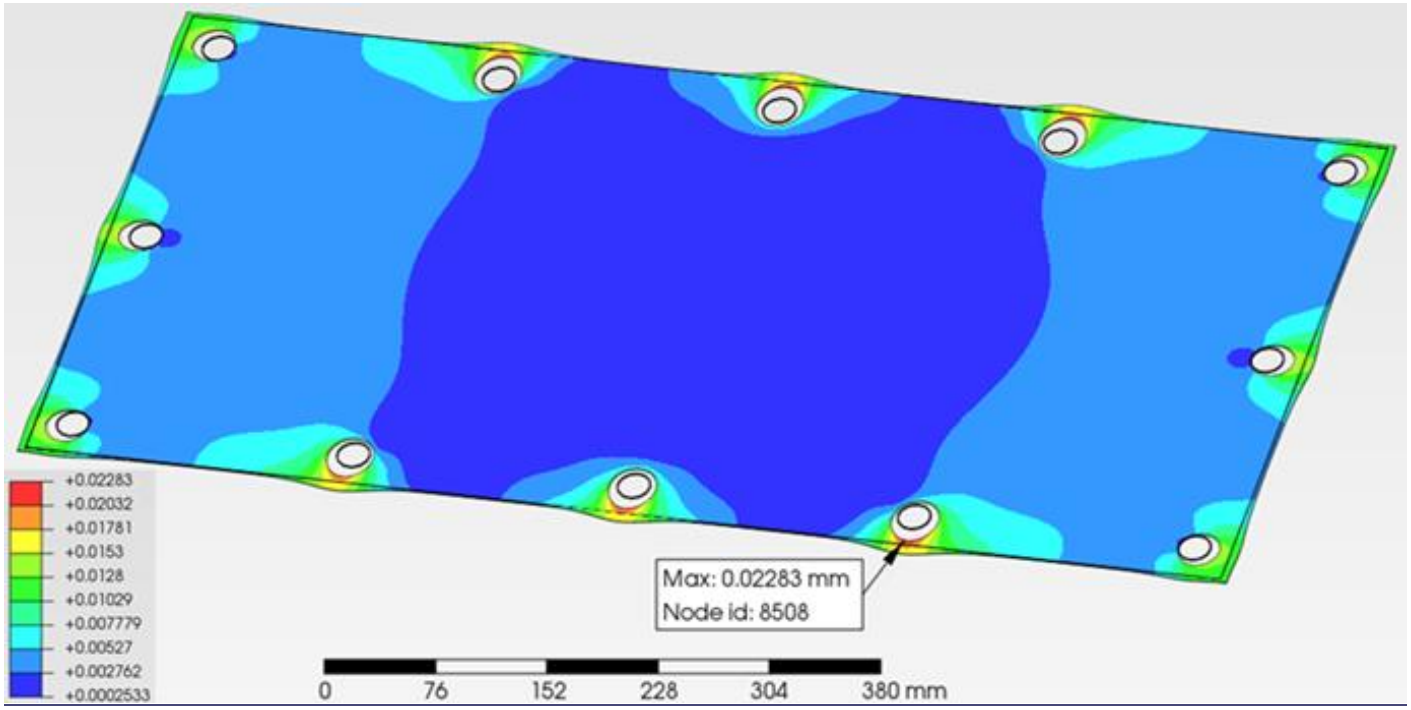

Figure 2.13: Simulation of the displacement that occurs in the bipolar plate by appling a pressure of 30 bar.

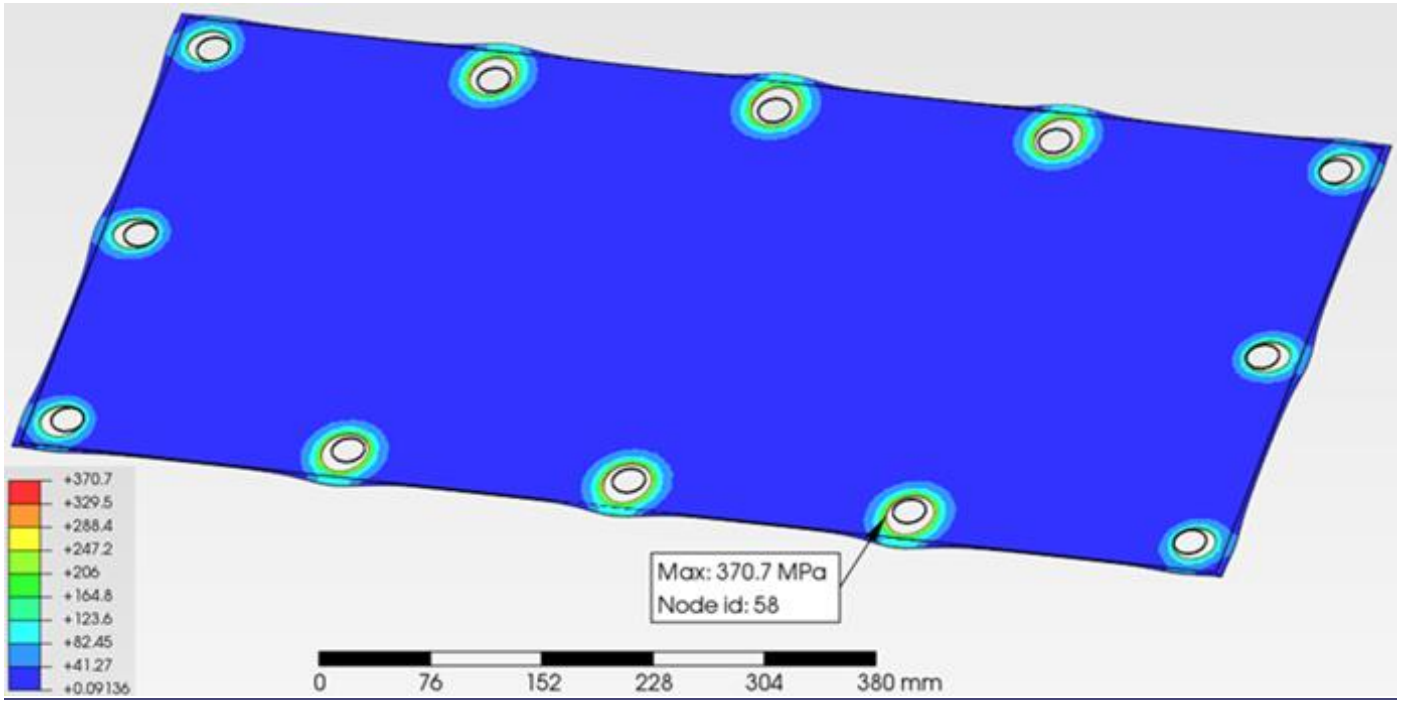

Figure 2.14: Simulation of the stress that occurs in the bipolar plate by appling a pressure of 30 bar.

Other simulations with a thicker bipolar plate were made.

Bipolar steel 316L 2 mm P=30 bar before adding the reinforcement bars

Figure 2.15 and Figure 2.16 show respectively the displacement and stress that occur in the 2 mm thick bipolar plate after applying a pressure of 30 bar. These simulations were done considering the initial cell design in which there are five bars on the long side of the cell.

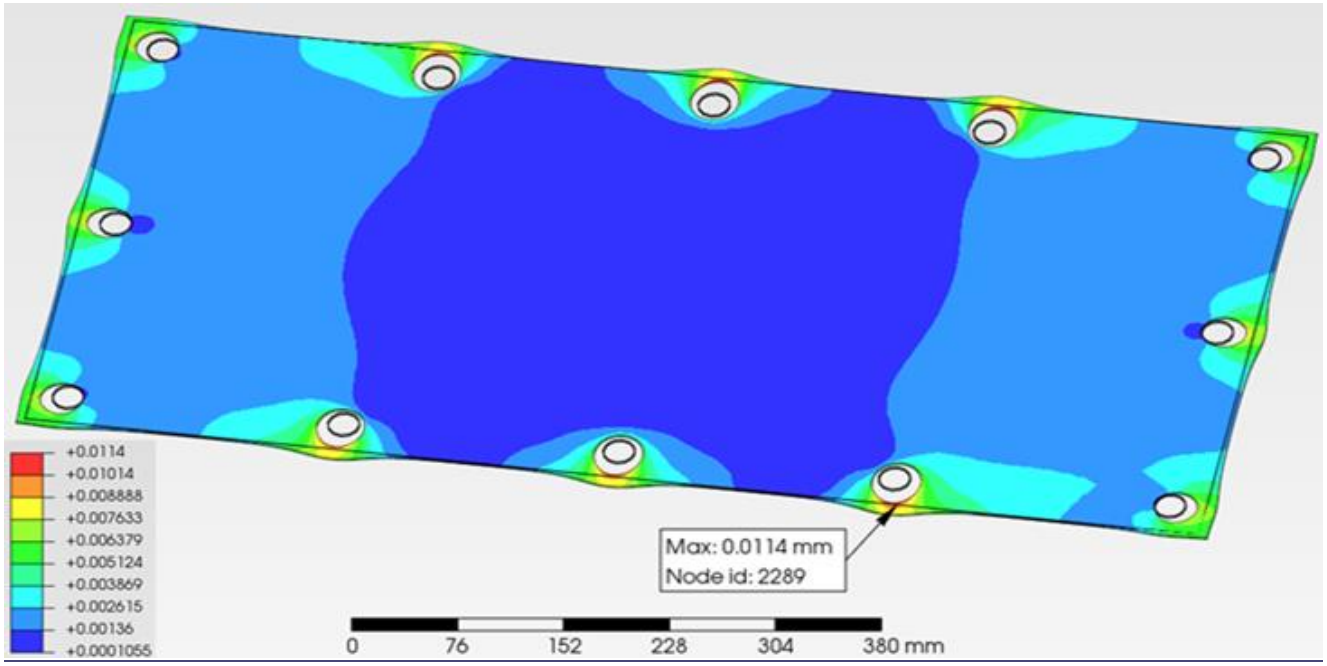

Figure 2.15: Simulation of the displacement that occurs in the bipolar plate by appling a pressure of 30 bar.

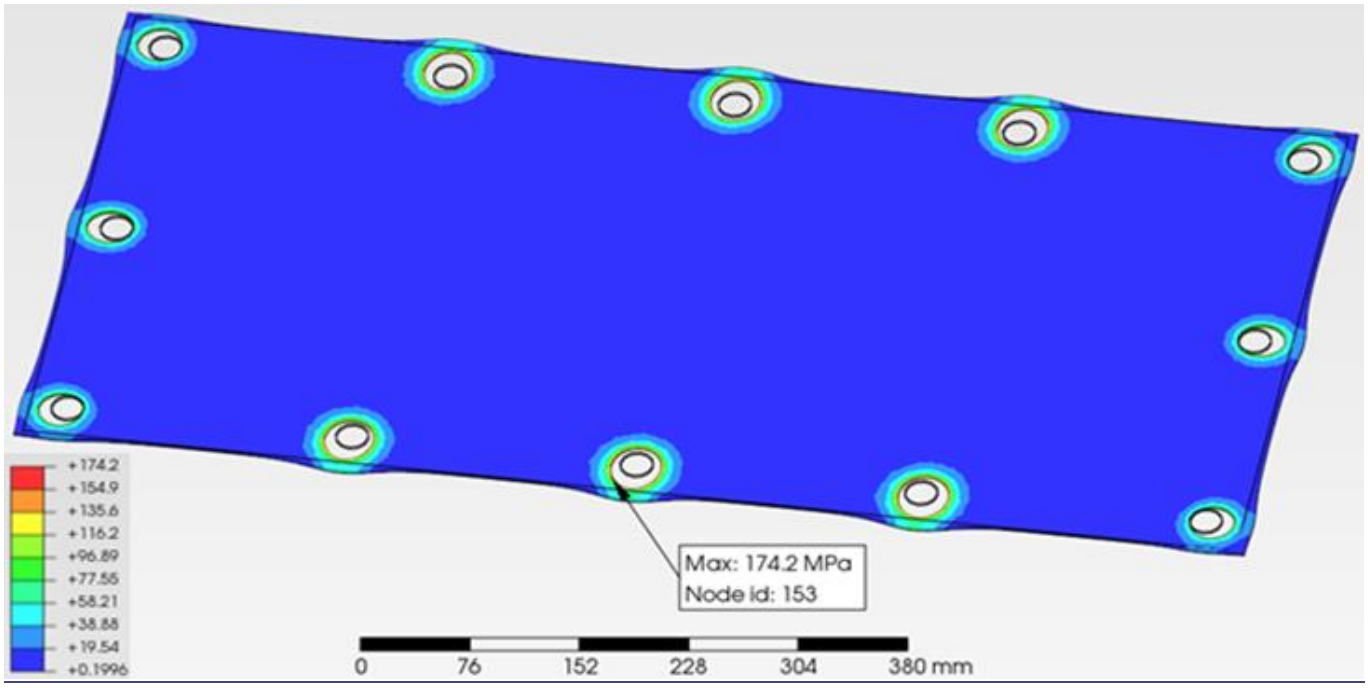

Figure 2.16: Simulation of the stress that occurs in the bipolar plate by appling a pressure of 30 bar.

As we expected, by increasing the thickness of the bipolar plate we obtain lower displacement and lower stress.

Endplate steel 316L 25 mm P=30 bar before adding the bars and with reinforcement bars

Figure 2.17 and Figure 2.18 show respectively the displacement and stress that occur in the endplate after applying a pressure of 30 bar. These simulations were done considering the initial cell design.

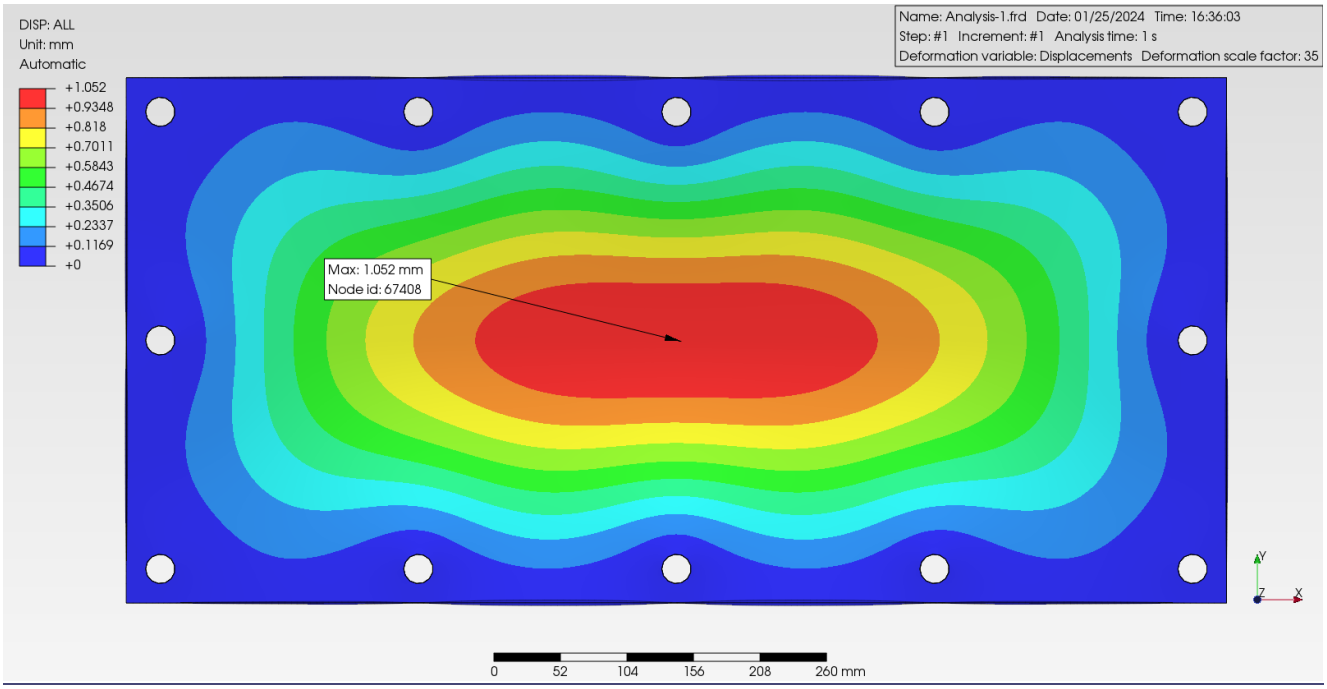

Figure 2.17: Simulation of the displacement that occurs in the endplate by appling a pressure of 30 bar.

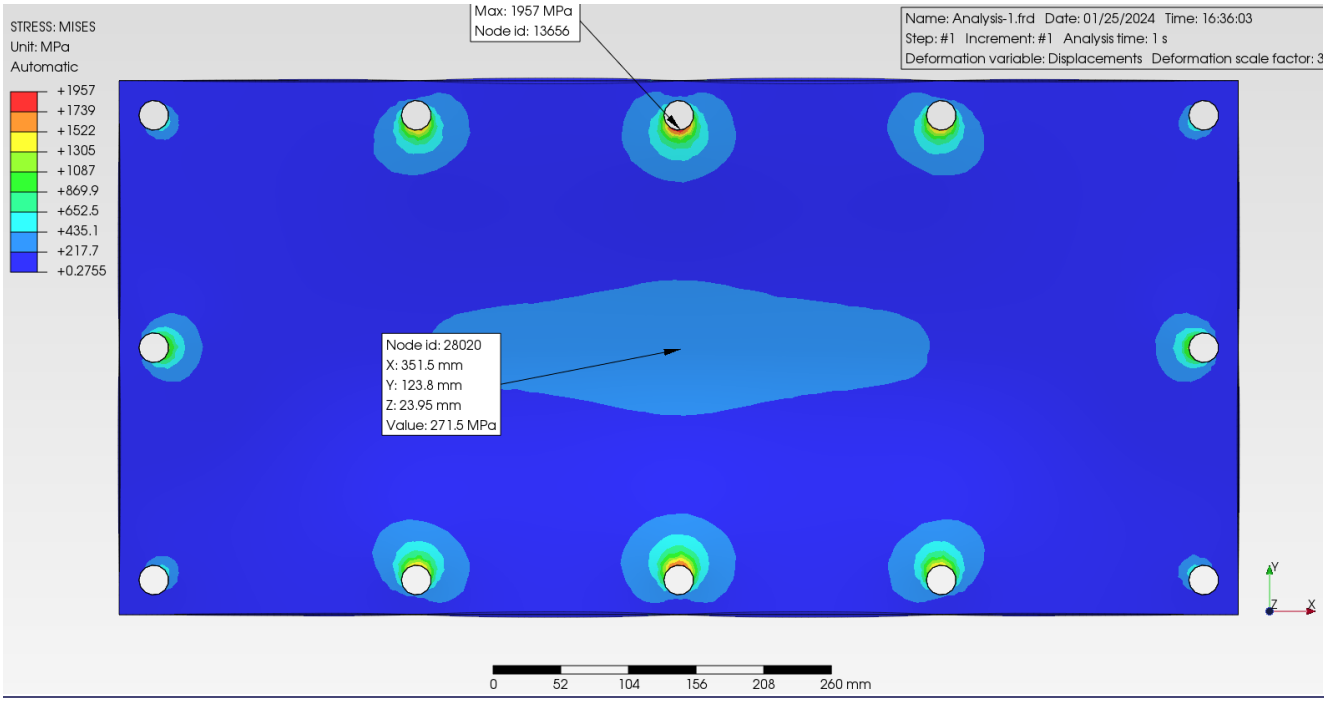

Figure 2.18: Simulation of the stress that occurs in the endplate by appling a pressure of 30 bar.

Endplate steel 316L 25 mm P=30 bar after adding the bars, with reinforcement bars and the actual design

In order to reduce and to make more homogeneous the displacement and stress on the endplate, we repeated the simulations with a new design. In this design two bars were added on the long side of the cell and we also added three reinforcement bars. Figure 2.19 and Figure 2.20 show respectively the displacement and stress that occur in the endplate after applying a pressure of 30 bar.

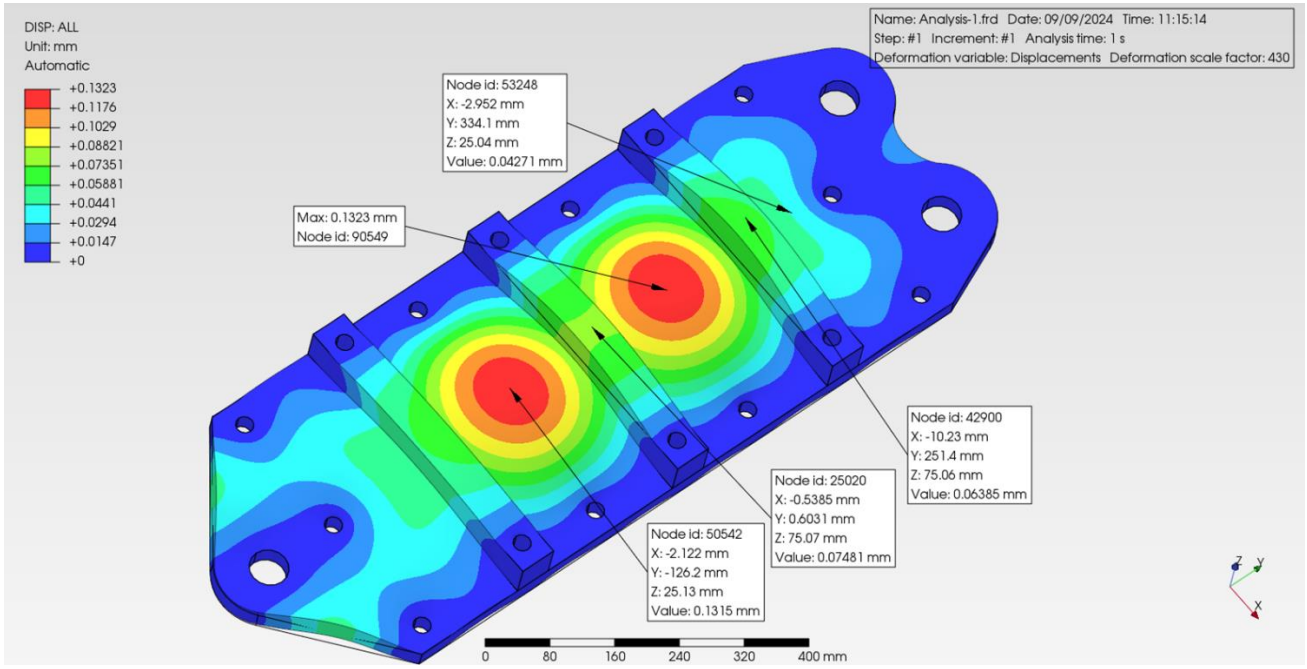

Figure 2.19: Simulation of the displacement that occurs in the endplate by appling a pressure of 30 bar.

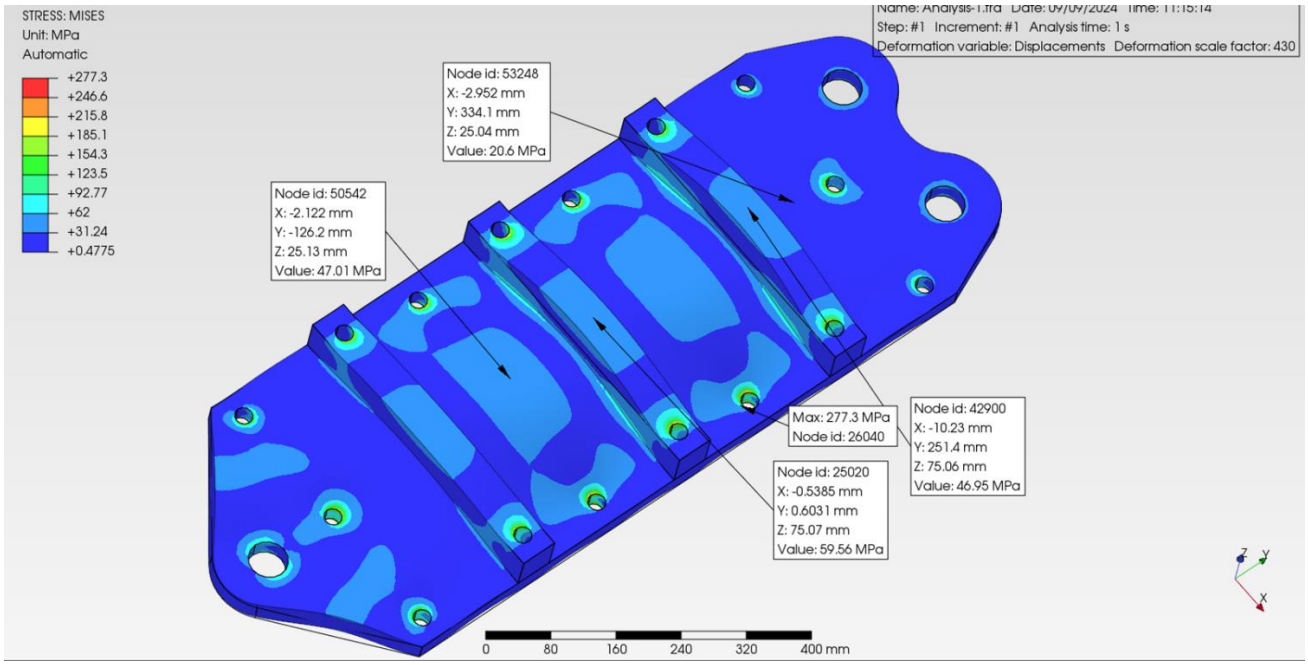

Figure 2.20: Simulation of the stress that occurs in the endplate by appling a pressure of 30 bar.

The actual proposed design shows improvements in distribution and reduction of displacement and stress.

CFD simulations

We started with simpler geometries and gradually moved to more complex ones to achieve a flow within the cell that is as linear as possible. From the simulations we arrived at the following internal geometry of the optimized cell (Figure 2.21).

Figure 2.21: Internal geometry of the optimized cell. Flow inlet is represented by the blue area and flow outlet is represented by the red area.

This geometry gives the following result.

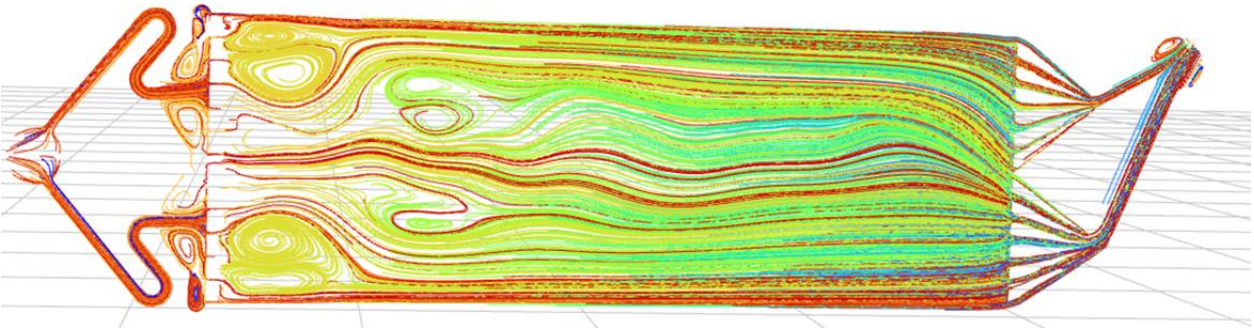

Figure 2.22: Simulation of the flow inside the cell .

The Figure 2.22 represents the flow inside the cell. The setup of the simulation, with particle path analysis, gives us a first estimation of the performance, while a complete simulation, introducing the process parameters is planned before the milling of the parts, but no peculiar variations are expected. From this simulation we can see how after an initial area with more turbulence the flow becomes linear.

3.2.4.3 SubTask T3.2.3 construction of single cell test rig

Testing the materials and proposed solutions requires a test fixture that can, on a small scale, validate performance through real measurements.

For this purpose, MMI has adapted the design of standard product (HPECS cell) to host the PEACE project parts and solutions.

The composition of the single cell is very simple and, on a square area of 25 cm^2 can test different parts and solutions in rapid sequence, making performance comparison easy.

The cell was originally implemented with flat gaskets- as can be seen by the exploded view (Figure 2.23)-, and realized with the materials of choice simulated in the previous subtask.

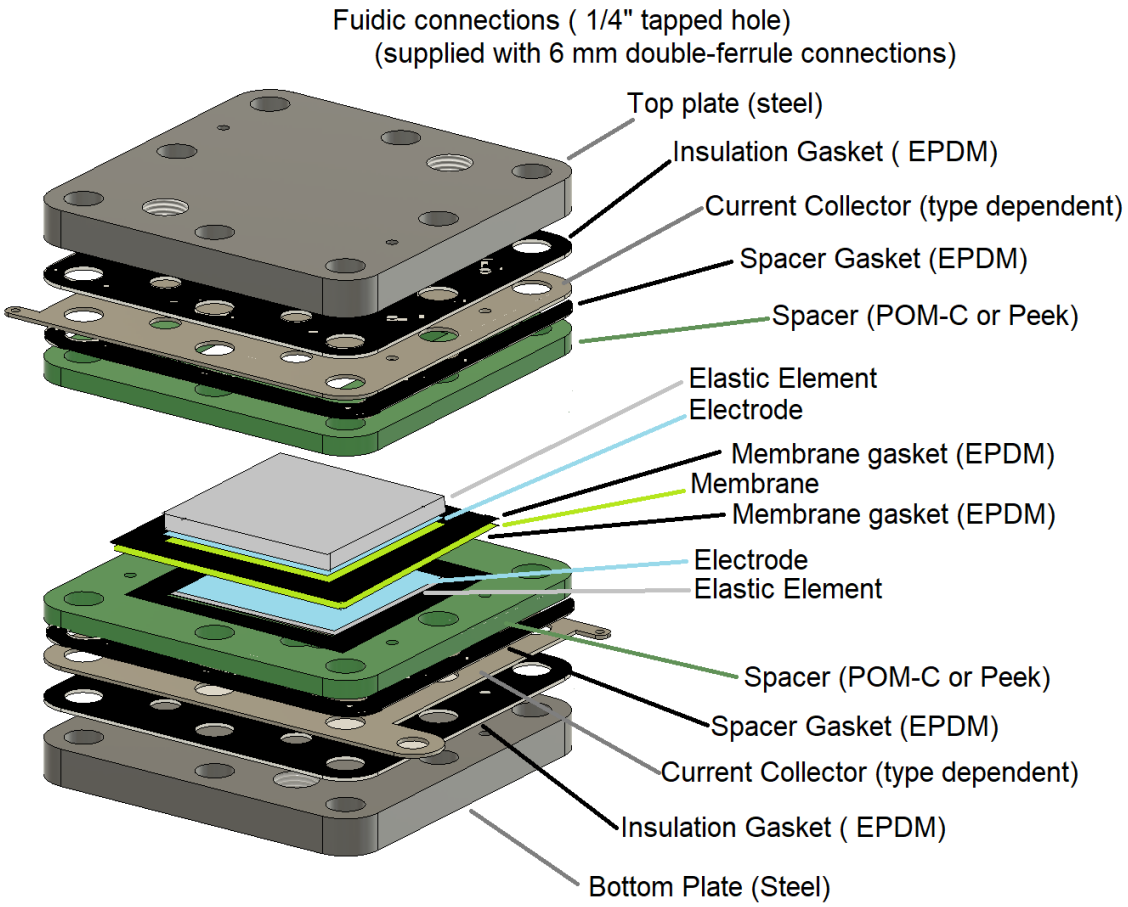

Figure 2.23: Exploded view of the cell.

The sealing of the cell is performed through 8 x M8 nuts and bolts, with spring washers mainly due to stand the thermal expansion of the materials during the tests.

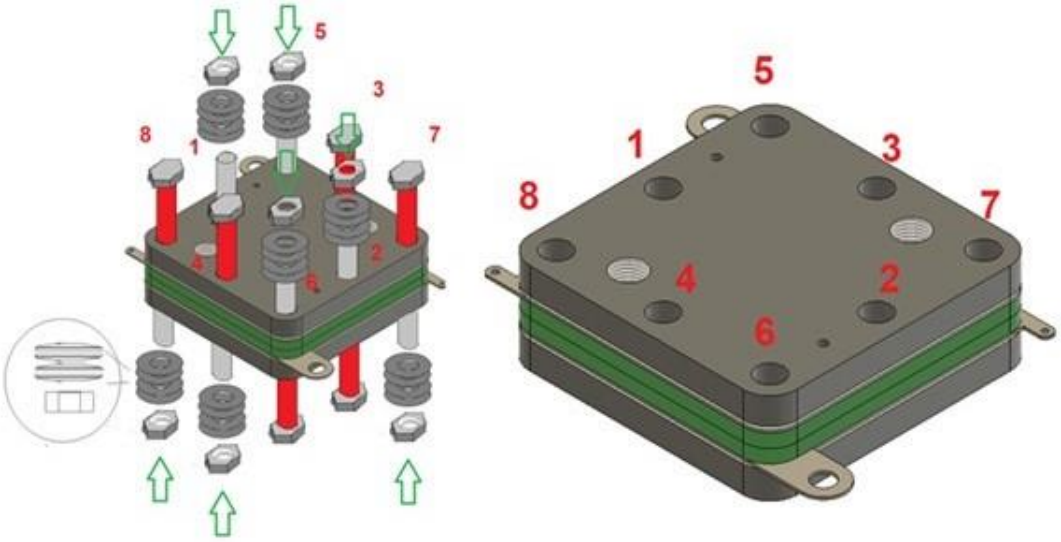

Figure 2.24: The sealing of the cell with the sequence of tightening the bolts.

The sequence of tightening the bolts was indicated, in Figure 2.24, being of main importance for the good sealing of the surfaces

The picture of a mounted cell with the fittings ready for tests is shown in Figure 2.25.

Figure 2.25: A mounted cell with the fittings ready for tests.

3.2.5 SubTask T3.2.4/5/6 test of single cell test rig with evaluation and re-design of parts

The previous cell was mounted and tested for performance of the parts: the ongoing process by other partners in the developing of the electrodes suggested us to check first the other parts (elastic elements spacers and o-rings), keeping the electrode qualification aside.

The cell was mounted in a test rig with the availability of full control on parameter's variation in pressure (up to 5 bar in existing test rig, to be extended) temperature to 90 °C and normalized flow to 30 ml/cm²/min in both sides. The test bench used is shown in Figure 2.26. The inner surfaces of the test rig were all plastic to prevent undue pollution of the experiment.

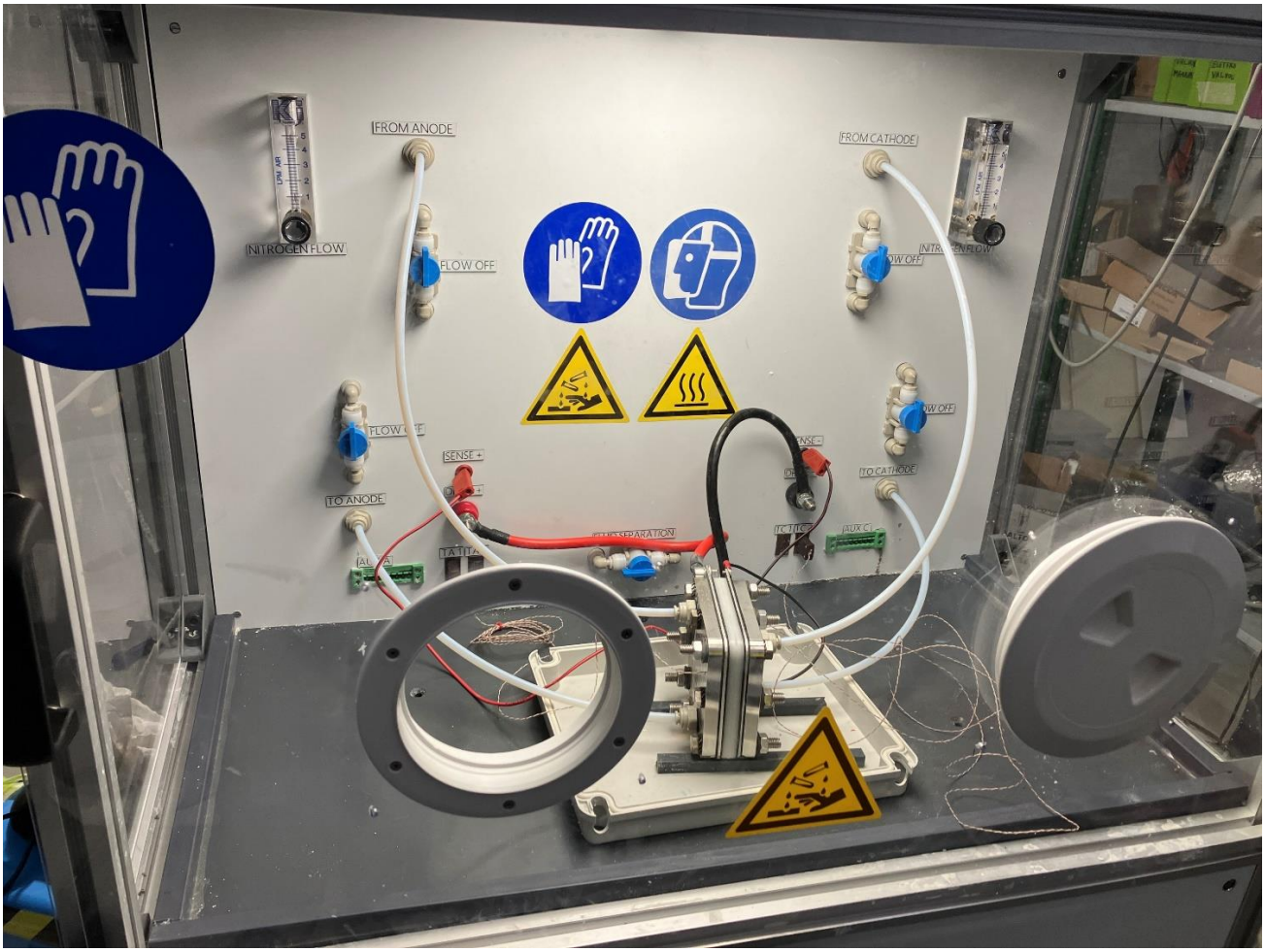

Figure 2.26: Test bench.

The elastic element was of the formed sheet type to test the concept: the result after roughly 300 hours can be seen on the right (Figure 2.27).

Analysis are now performed on the run sample because seems the deteriorated surface is due to a deposited material not belonging to the steel plate itself but related to a not performing EPDM rubber with a mineral and carbon black load not compatible with the KOH solution at that temperature

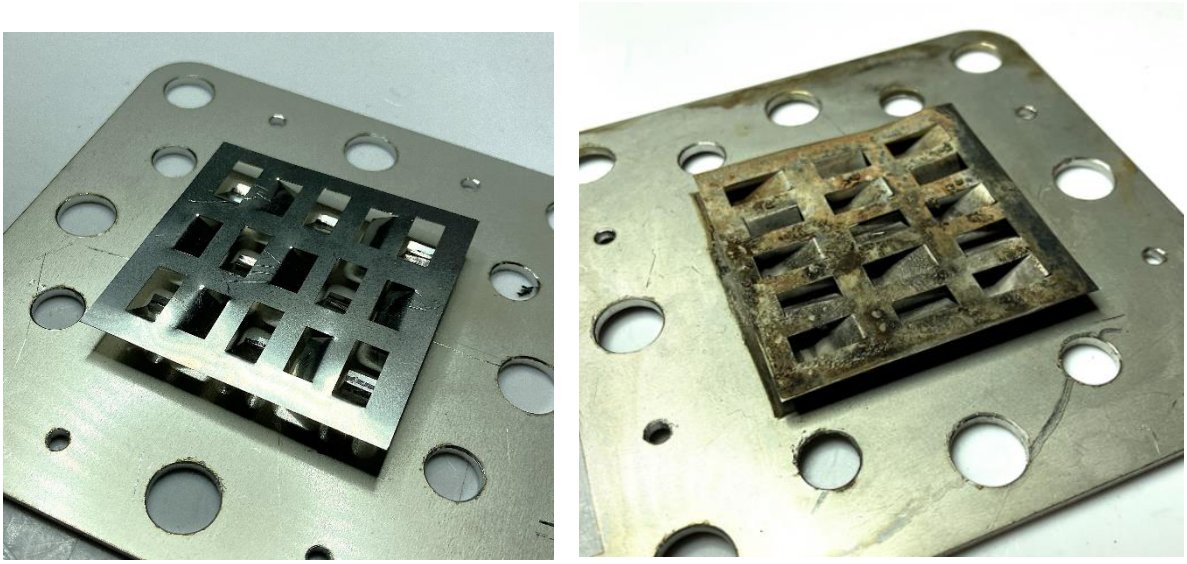

Figure 2.27: Elastic element mounted in place (left picture) and its degradation after roughly 300 hours of operation (right picture).

A sheet of food-grade EPDM rubber, with improved chemical properties is on the way to us for testing.

The tests performed extended to the o-ring type of gasketing with good results.

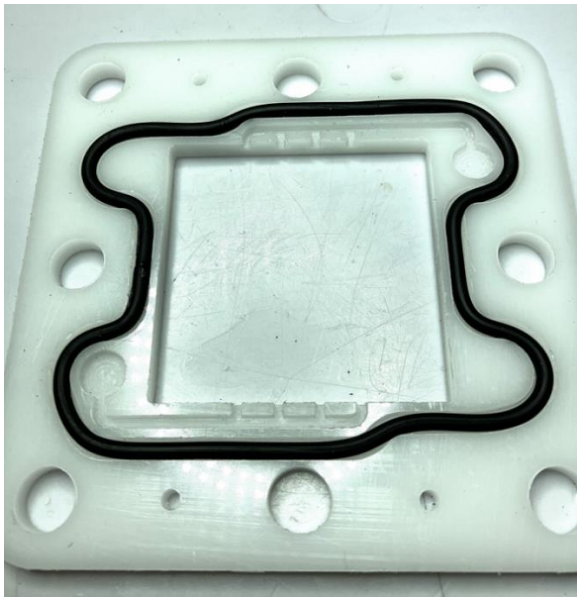

Figure 2.28: O-ring gasketing.

The spacers with o-rings shown in the Figure 2.28 stood tight to 35 bar pressure test outside the test bench and are now mounted on a cell for a temperature and chemical compatibility test.

The new configuration shown some sensitivity to the inner surface's quality, leading us to the use of different tooling on the mill.

Tests to 60 bars are now planned for execution to verify the limits of this technology with solicitations of pressure-temperature – chemicals all applied at the same time in a static mode before testing it on a full operating system.

4 Conclusion

The deliverable 3.1, that constitute the first milestone for the WP3 is the result of two main tasks: the identification of all the materials and technologies needed for the construction of the stack and other ancillaries, and the drawing of the functional appearance of the stack itself, within the objective of the project's demonstrator set at 50 kW /30+ bar overpressure.

Both tasks were performed obtaining important side information that was shared with the other partners about materials, zero-gap strategies and innovative approach to some basic components like the elastic elements.

The single cell activity brought to the PEACE project partners a shared platform and objects to perform tests under the same boundary conditions on all the critical components, optimizing tests' timing and data exchange.

The first subtask, that include the purchase of a gantry mill to build the plastic spacers and the cutting of proper gaskets is now complete, and grants extremely fast turnover of the qualification process, with drawing-realization-testing process executed on a week scale instead of the usual months needed for the task.

The drawing of the stack, executed within the boundaries given by the existing pressure vessel's dimension, shows a promising performance profile for both the fluidic of the system and the thermal behaviour, with reduced heat exchange path thank to a thin design that makes the inner parts in better contact with the external volume.

The timely meetings and reports along this first time slot, managed by our coordinator, allowed us to fulfil the first part with the added experience of all the partners and this procedure will be kept, thanks to the good results, for all over the project extent.

We are now preparing for the first short stack assembly, where the technologies identified will be used in a first life-size object before the assembly of a full-sized stack.