

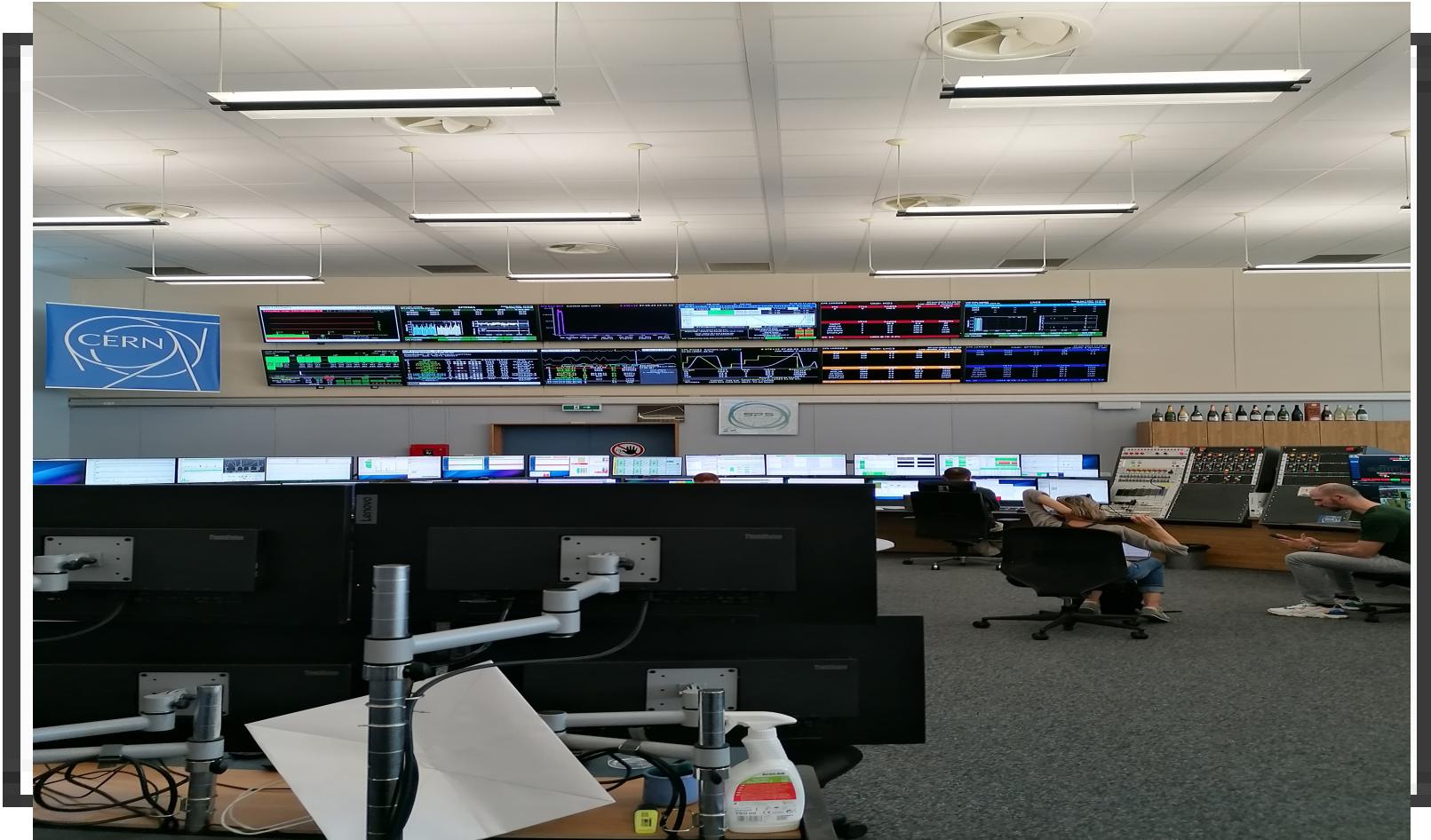
Expérience de Stage au CERN

Cybersécurité et Développement

Présentation de l'Entreprise

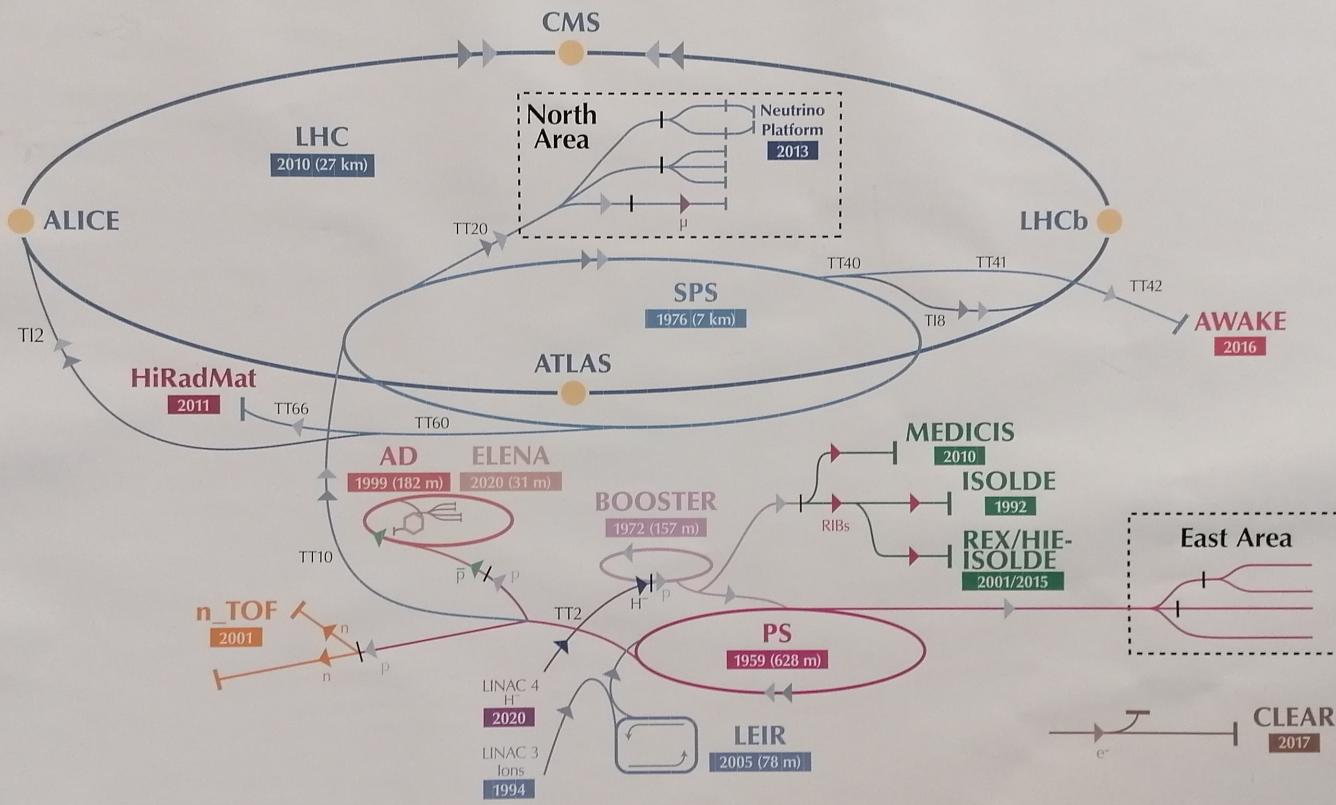
- CERN - Centre Européen pour la Recherche Nucléaire
- Secteur : Recherche en physique des particules
- Le CERN est à la pointe de la recherche en physique des particules et de la technologie de l'information

Salle de Contrôle

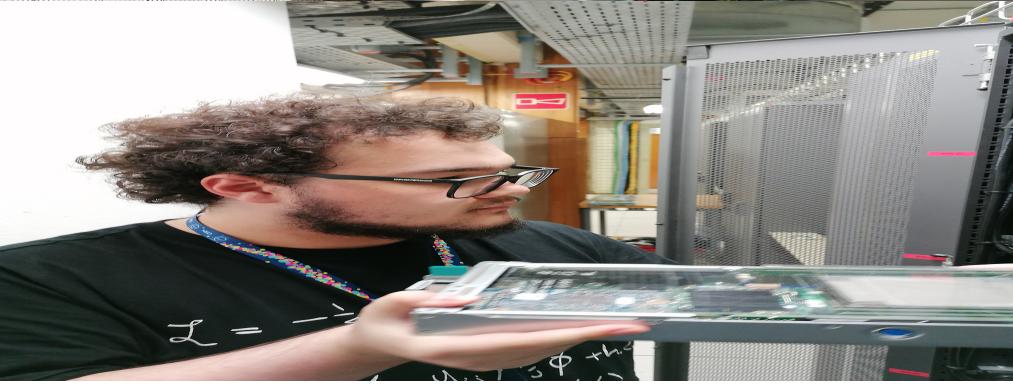
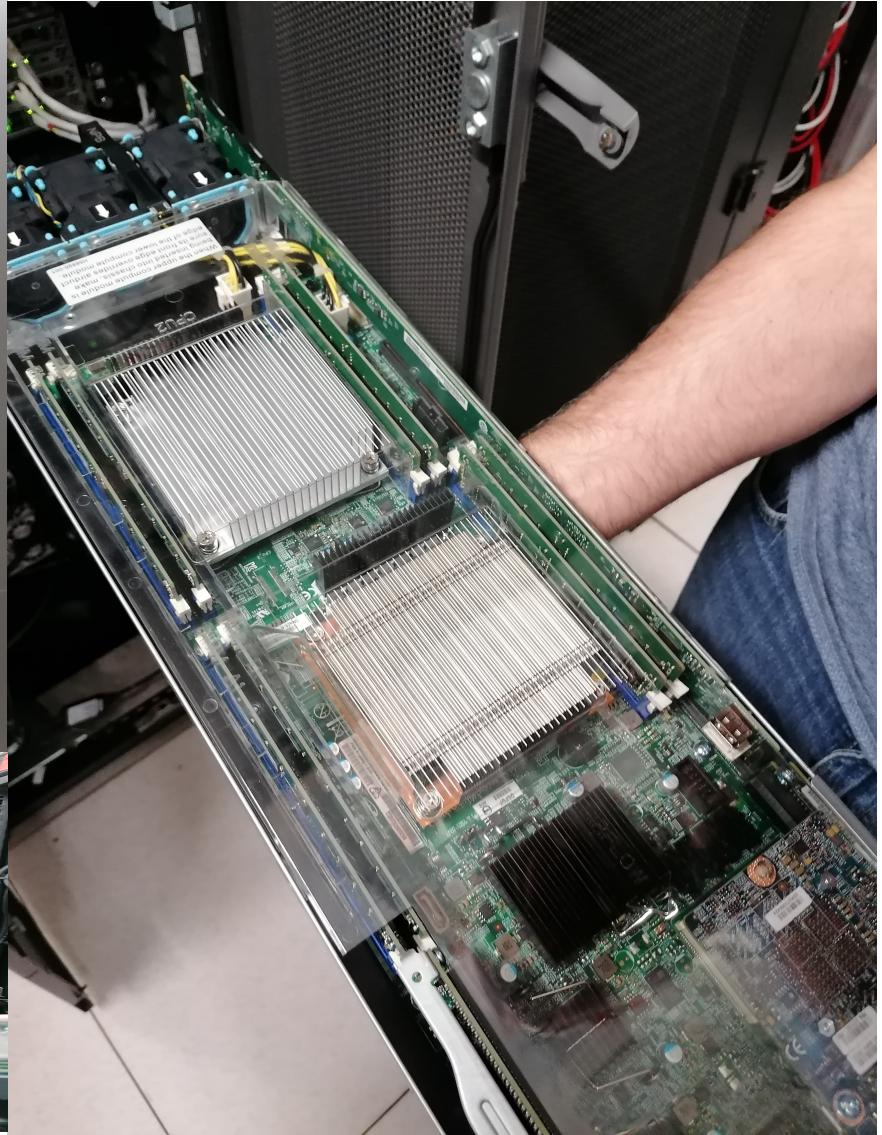
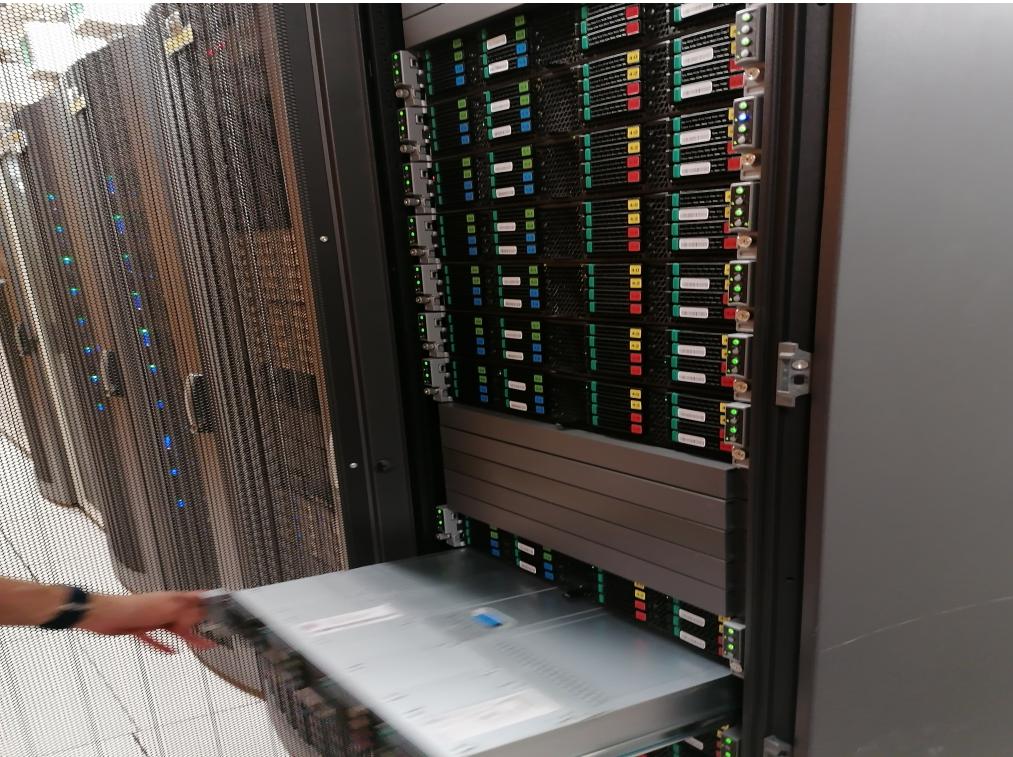


Carte des accélérateurs

The CERN accelerator complex
Complexe des accélérateurs du CERN



Équipement informatique (salle des serveurs)



Système de refroidissement de l'accélérateur



Sous terrain



Salle de d'analyze



Usine d'anti matière



Intérieur de l'usine



Manufacture des bobines



Manufacturing process of the MQXFB coils for HL-LHC

The coil manufacturing process is organized in three main phases: a) Winding and curing, b) Reaction heat treatment and c) Epoxy impregnation. The fabrication follows a detailed QA/DC plan, which foresees several QA controls and electrical verifications.

From the beginning of the process, meaning from the inspection of the insulated cable until the impregnated coil finished and measured, about 2.5 months are needed.

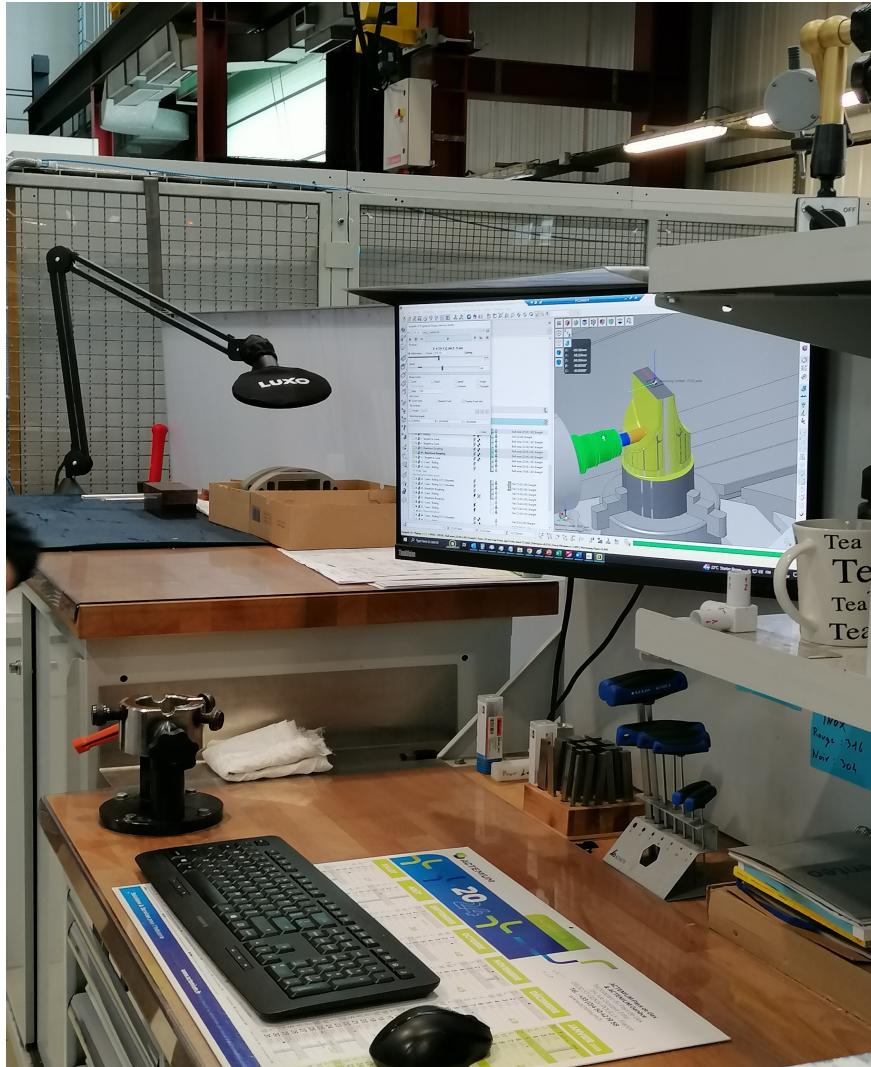
a) Winding & curing:
The coil is composed of 50 turns, wound in two layers using a single unit length of cable (no internal splice). The cable is insulated with braided-on Si glass 0.145 mm² and is wound around 17 segmented titanium poles, fixed to the winding mandrel. The two coils under process is launched to give the proper azimuthal size to the coil and cure the ceramic binder applied on the II, of the coil (1 h at 60 °C and 2 h at 160 °C).

b) Reaction heat treatment:
After winding and curing, the coil must undergo a Nb₃N formation heat treatment under Argon atmosphere:

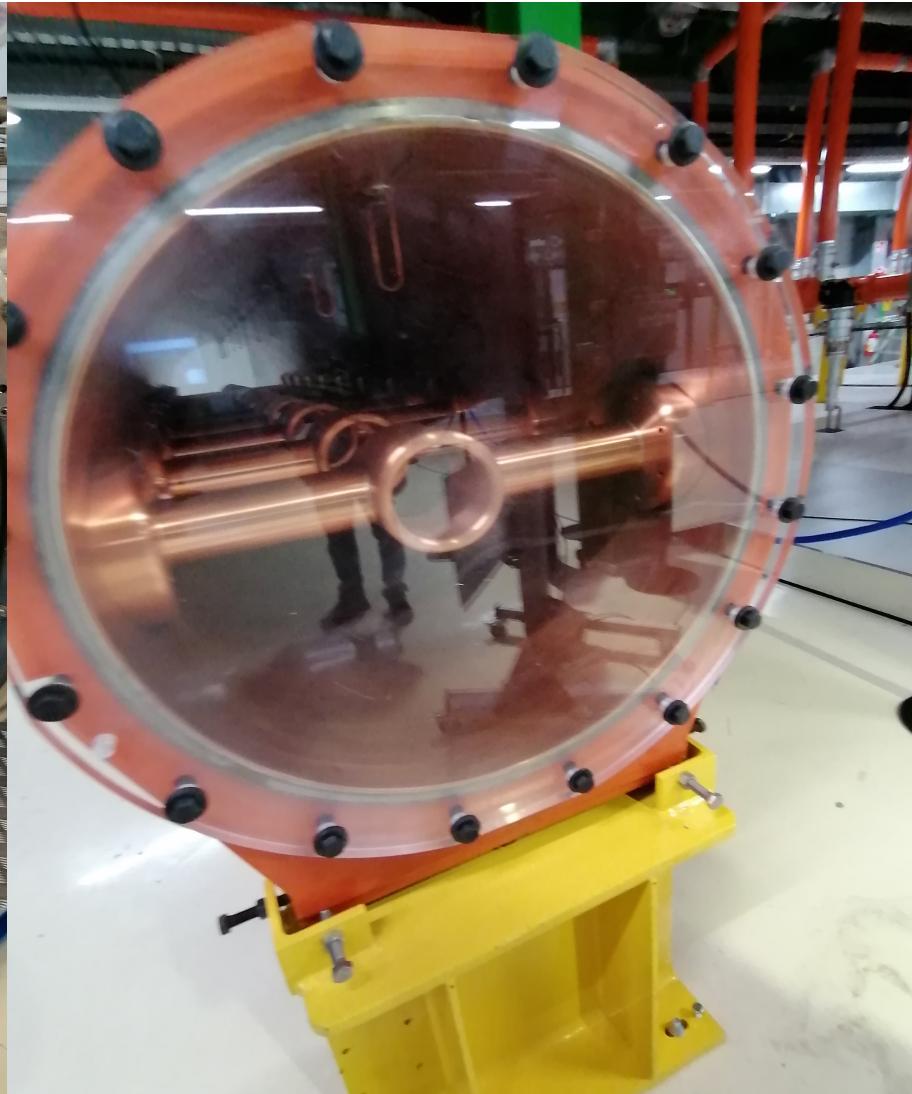
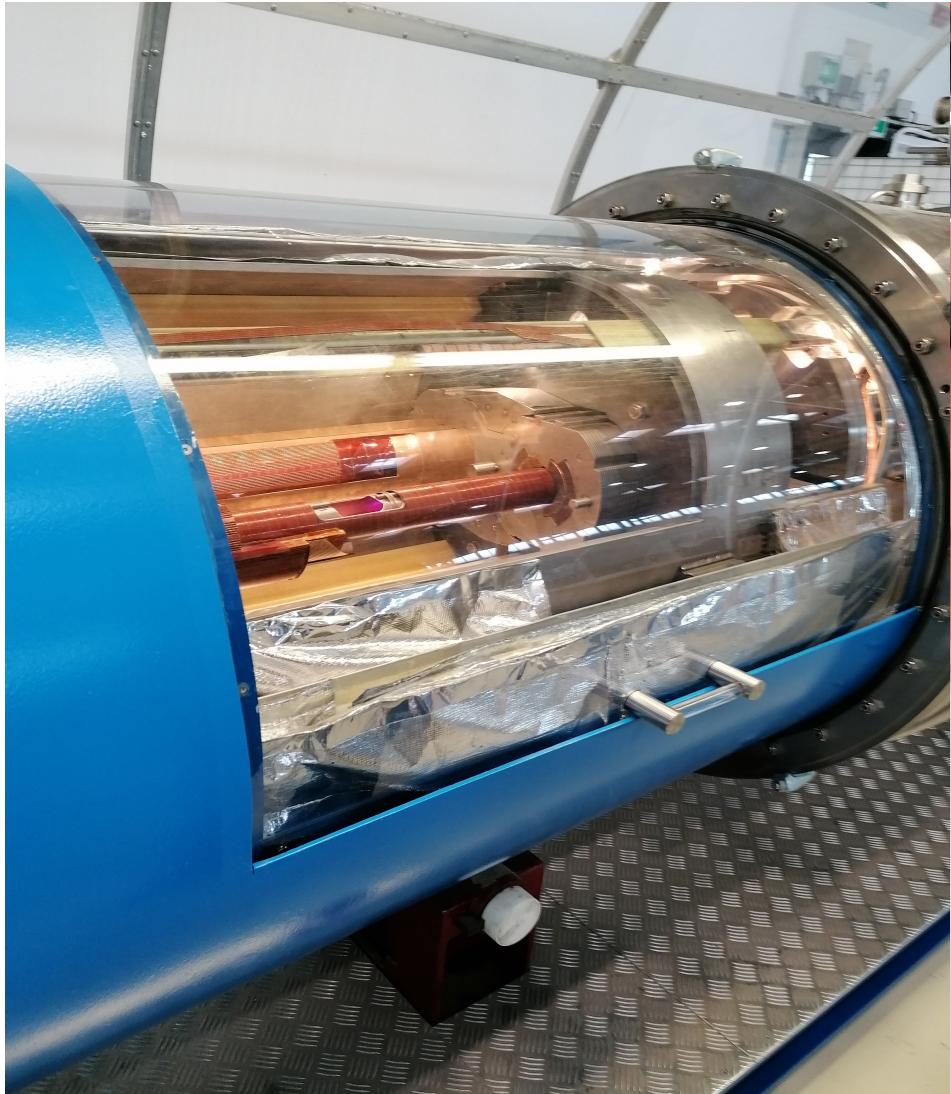
Power	T (°C)	Duration (h)	Ramp/Decr. (°C/h)
1	230	48	25
2	400	10	50
3	600	10	50

c) Epoxy impregnation:
After RHT, the outer insulation tooling is gradually opened, and Nb-Ti cables are spliced to the embedded Nb₃N leads. The preparation for impregnation is performed in 3 steps, minimizing the manipulation of the brittle coil. Afterwards the coil is vacuum pressure impregnated with CTD-301X epoxy to provide mechanical stability and electrical insulation to the coil, as well as protection against the radiation dose expected for Hi-Lumi (injection at 60 °C, cure at 110 °C for 5 h and post-cure at 125 °C for 16 h).

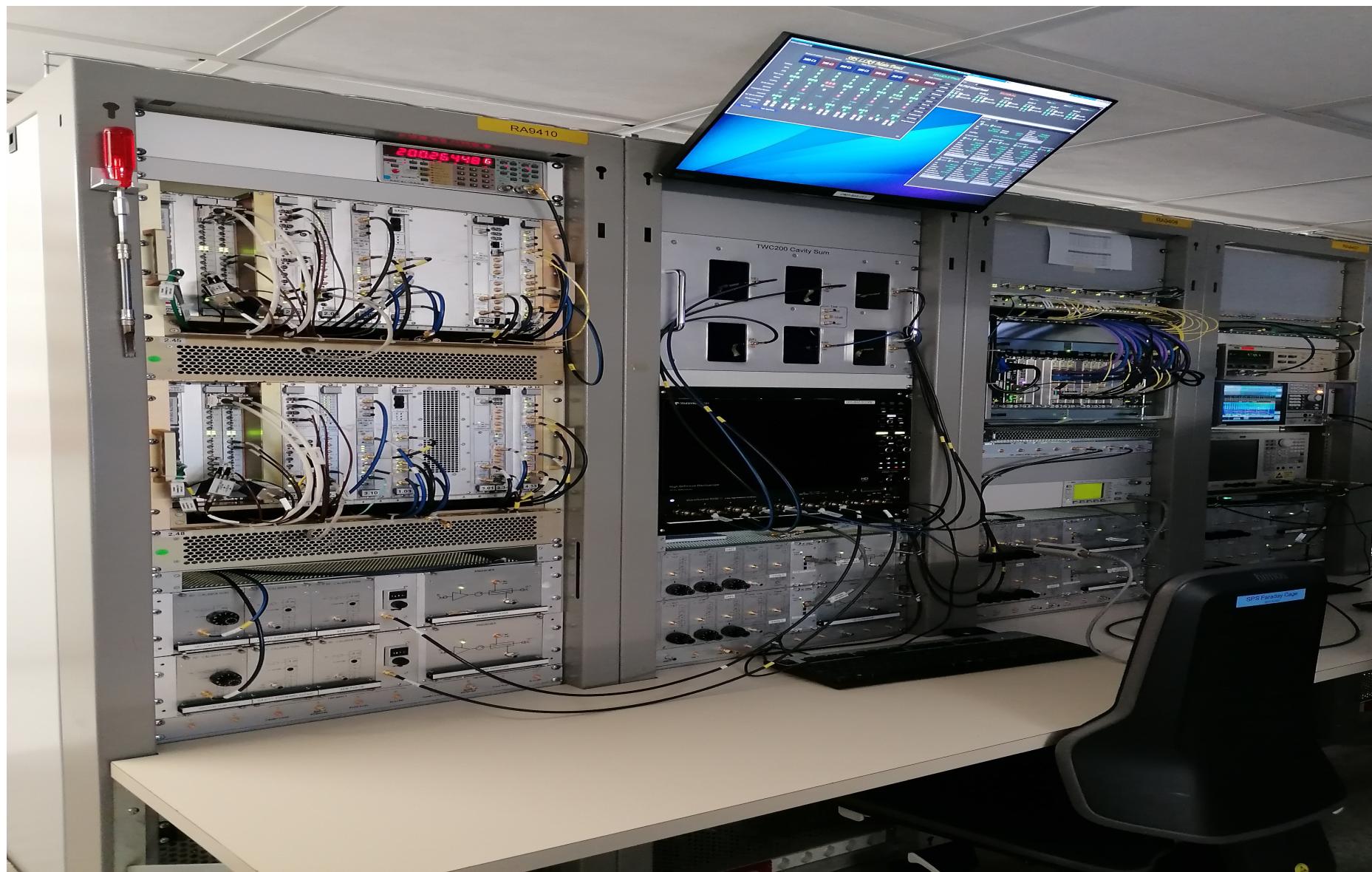
Manufacture par modelage 3D



Bobine éléctrique



Salle de maintenance



Objectifs du Stage

- Créer un processus de code pour la signature numérique et la détection de failles
- Assurer la conformité pour l'application sur le cloud des services

Processus de Code

- Création d'un processus de code pour la signature numérique
- Détection de failles et scan via GitHub Actions

Outils Utilisés

- Trivy : Détection des vulnérabilités dans les images Docker
- SBOM : Inventaire des composants logiciels
- Cosign : Signature numérique des images Docker
- GitLab CI/CD : Automatisation des pipelines

Développement de Scripts

- Scripts pour l'intégration de SBOM (Security Bill Of Material)
et Trivy
- Automatisation des processus de sécurité

```
- cosign attest --predicate bom.json --type cyclonedx "$IMAGE_DIGEST"  
- cosign sign --annotations "sbom=$(cat bom.json | base64)" "$IMAGE_DIGEST"
```

Automatisation des Pipelines CI/CD

- Automatisation des pipelines CI/CD sur GitLab
- Génération, validation et conversion du SBOM de dépendances Python

```
generate-sbom:  
  stage: build  
  script:  
    - cyclonedx-py requirements -o bom.json  
    - cyclonedx validate --input-file bom.json --fail-on-errors  
    - cyclonedx convert --input-file bom.json --output-file bom.xml
```

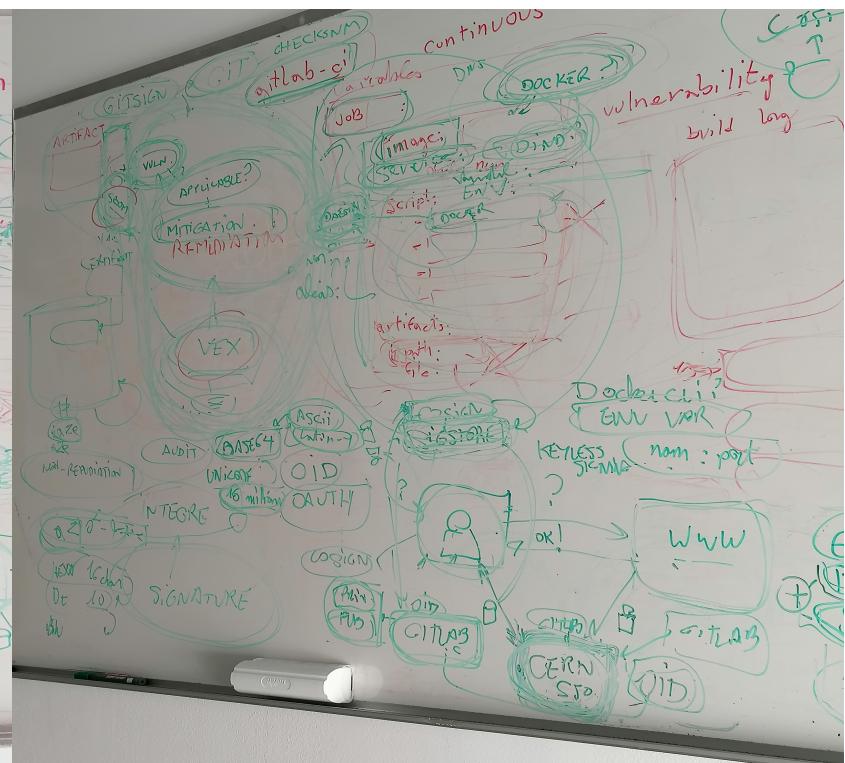
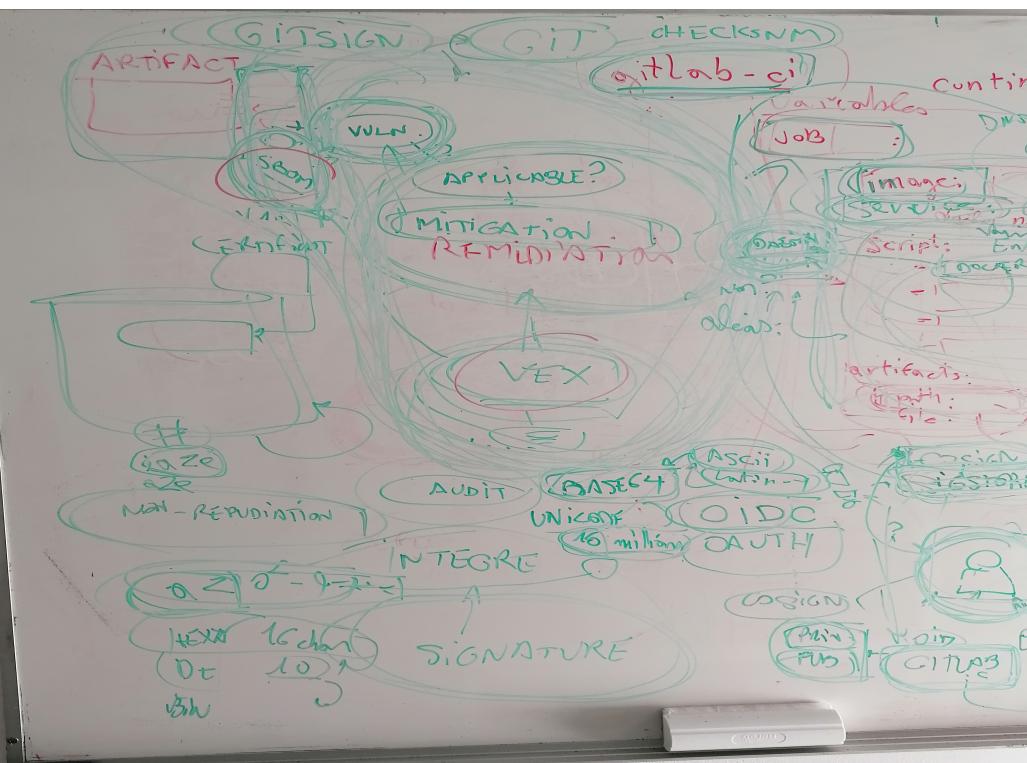
Compétences Techniques

- Utilisation de Trivy, SBOM, Cosign, GitLab CI/CD
- Développement de scripts et automatisation

```
- trivy image $CI_REGISTRY_IMAGE:$CI_COMMIT_SHA \
  --scanners vuln \
  --format template \
  --template '@/contrib/gitlab.tpl' \
  --output gl-container-scanning-report.json
```

Compétences Professionnelles

- Collaboration et communication technique
 - Résolution de problèmes techniques
 - Gestion de projet et organisation



Réalisations

- Mise en place de processus de sécurité efficaces
- Contribution à la sécurité des applications et des conteneurs Docker

Dynamic SBOM management

Generation

- GitLab SCA scanners run in the pipeline and creates CycloneDX SBOMs for dependencies.



- 3rd party CycloneDX generators can also be used.

Ingestion

- Any CycloneDX SBOM produced by the pipeline is ingested into GitLab automatically and stored in our database.



Continuous Analysis

- Dependencies are continuously analyzed for licenses.
- Dependencies are continuously analyzed for vulnerabilities.



Merge & Distribute

- View the SBOM in the GitLab UI in the Dependency List.
- Export a combined/merged JSON file including license and vulnerability data from either the UI or a pipeline.

Impact

- Importance de la cybersécurité dans le développement rapide des technologies
- Potentiel d'investissement futur dans le domaine

The screenshot shows a dark-themed news aggregator website with four news items listed:

- L'histoire de la cyberguerre et les 5 attaques les plus connues** (Fortinet) - A news item from Cyber Management School about the history of cyberwarfare and the top 5 known attacks.
- Les 8 incidents en cybersécurité qui ont marqué l'histoire.** (Cyber Management School) - A news item from 3 sept. 2024 about eight incidents in cybersecurity history, mentioning the WannaCry ransomware attack.
- Les failles de cybersécurité de ces 5 dernières années** (Blog Cybersécurité) - A news item from 11 sept. 2023 about five major security flaws in recent years, mentioning Stuxnet, WannaCry, and the Ashley Madison data breach.
- Découvrez les 5 cyberattaques les plus marquantes** (Mailinblack) - A news item from 22 oct. 2024 about five major cyberattacks, mentioning the Trojan Horse, WannaCry, Petya, and NotPetya viruses.

Conclusion

- Résumé de l'expérience et des compétences acquises



Remerciements

- Remerciements au CERN et au tuteur

Tuteur : Brice COPY



Secrétaire : Elodie Duport