Attachment 1

External Experts Areas of Expertise

1 - Complex civil constructions, nuclear buildings
   - Secondary work
   - Finishing
   - Heating Ventilation and Air Conditioning
   - Fluids
   - Nuclear ventilation
   - Cranes and handling device
   - Architect
   - Painting
   - Commissioning
   - Metal work
   - Construction contract adjudication
   - Construction claim assessment (schedule and cost)
   - International construction contract administration (FIDIC, NEC, cost reimbursable, etc.)
   - Work measurement

2 - High and medium voltage technology
   - Power supplies
   - Power electronics
   - Power conversion
   - High Voltage
   - Electromagnetic compatibility
   - Earthing/Grounding

3 - Project and Programme Management
   - Planning and scheduling (Primavera, resource loading, baseline)
   - Earned Value Management
   - Risk Management (facilitation of identification or handling strategies workshops, schedule Montecarlo simulations)
   - Cost Assessment (cost escalation, indexation, cost baseline, basis of estimate)
   - Agile project management methodologies
   - Contract and Performance Management
   - Project Change Management
   - Configuration Management
   - Supplier management
   - Engineering/production processes
   - Complex manufacturing contracts
   - PDM/PLM systems
   - Work Breakdown Structure (WBS)
   - Product Breakdown Structure (PBS)
   - Systems engineering (INCOSE)
• Requirements management (DOORS)
• Interfaces Management

4 – Human Resources Management
• Job classification
• Staff Performance management
• Competency frameworks
• E-learning
• Talent management

5 – Documentation and Business Process Management
• Business Process Management (BPM)
• Documentation management (DMS)
• Improvement and organisational change management
• Lean Six-Sigma

6 – Quality
• Quality Assurance
• Quality Control

7 - EU or International regimes/regulation for the control of exports, transfer, brokering and transit of dual-use goods and technology.
• Compliance with the European Union Dual-Use Items Control Regime
• Dual Use items/technologies classifications
• International Export Control Regimes

7bis – Specific Regulatory Matters
• European Directives
• European Pressure Equipment Directive (including nuclear )
• French ESP/ESPN Regulation
• CE marking directives
• ATEX
• PED
• F-Gas
• EMC

8 – Transportation of nuclear and conventional large components
• Nuclear transportation regulation
• Incoterms
• Freight forwarding
• Logistics
• Technology
• Safety Analysis

9 – Large components for conventional and nuclear installations
• Pressure vessels for nuclear applications
• Regulations
• Complex welded structures
• Components subjected to high thermal loads

10 - Remote Handling systems for nuclear environment
• Mechanics,
• Rad-hard components
• Electronics,
• Control system
• Virtual reality
• Augmented reality

11 - Nuclear fusion components design
• Breeding blanket
• First Wall
• Divertor

12 - Plasma and First Wall diagnostics
• Optical
• Imaging
• Spectroscopic
• Microwave
• Neutrons and gamma rays
• Magnetic field
• Particle and pressure
• Physics
• Engineering
• Modelling
• Design
• Integration

13 - Tokamak machine diagnostics
• Optical systems
• Metrology
• Machine vision
• Image processing

14 – Tokamak Heating & current drive systems
• RF technologies,
• NB Systems
• Vacuum tubes
• Gyrotrons

15 - Tritium technology
• Water detritiation system
• Isotope separation system
• Tritiated produce processing, storage and handling

16 – Cryogenic technology
• Cryolines
• Helium technology
• Cryogenic materials
• Structural materials at cryogenic temperatures

17 - Vacuum & Leak Detection Technologies
• Components
• High level vacuum component
• Baking and outgassing procedures
• (hot) leak tests
• Surface cleaning and conditioning
• High vacuum in scientific projects
• Leak Detection

18 - Chemistry and Technology of liquid metals and ceramics
• Lithium technologies
• Liquid Metal Technologies
• Liquid Metal chemistry & corrosion
• Lithium ceramics

19 - I&C and CODAC
• Information engineering
• Electronic engineering
• Instrumentation engineering
• Fusion instrumentation
• System Engineering
• Fusion CODAS
• Large Experiments CODAS
• Investment Protection System
• Plant Safety Systems
• Nuclear Systems
• Fusion Plant Control
• Fusion Diagnostic System
• ATCA
• Compact PCI
• PCI express
• Real-Time Systems
• Distributed Real-Time
• Data acquisition
• Industrial SCADA
• Industrial Networks and FieldBuses
• EPICS
• Cable & Conduits
• Cubicles Design
• EMC expertise
• Electronic Design
• FPGA design
• Radiation tolerant electronics
• Robotic I&C
• Virtual Reality
• RF systems
• Microwave Systems
• HVAC Systems
• Fire detection Systems
• Power Distribution Instrumentation
• Power Supplies Instrumentation
• Surveillance Systems

20 - CAD-related technologies (CAD, Project Lifecycle Management)
• CATIA
• CATIA V5
• Enovia SmarTeam
• Enovia v5
• Virtual Lab. Motion CATIA [Kinematics]
• DMU Kinematics (CATIA)
• CATIA assembly module
• DELMIA
• AutoCAD
• CAD/CAM integration in PLM

21 - Water cooling, chemistry & corrosion technologies
• Water cooling
• Erosion of coolant water interfaces
• Radiolysis effects
• Crevice corrosion
• Stress Corrosion Cracking (SCC)
• In-situ monitoring and assembly of monitoring facilities (electrochemical potential, impurity accumulation, water sampling and test specimen assemblies using autoclaves)
• Qualification and assessment of metals and alloys used for coolant water interfaces

22 - Engineering & Design
• Nuclear systems design
• Mechanical Engineering
• Mechanical Design
• Electrical Engineering
• Civil Engineering
• System design and modelling
• Hydraulics
• Cooling systems engineering
• Nuclear engineering
• Geotechnical engineering
• SF6 gas handling: large SF6 gas handling system design (>1 ton)
• RAMI Analysis expertise - Dependability analysis

23 - Analysis and modelling
• Mechanical Analysis
• Civil engineering
• Earthquake, geotechnical and structural engineering
• Floor response spectra
• Soil structure interaction
• Structural Dynamics
• Analysis of reinforced concrete structure
• Analysis of fibre composite structures
• Experimental methods in structural mechanics
• Large-scale testing
• Blast and impact analysis
• Electromagnetic analysis
• Fluid dynamic,
• Computational Fluid Dynamics (CFD)
• Fatigue analysis
• Thermal mechanical analysis
• Nuclear analysis
• Neutronics analysis
• Nuclear Physics
• Superconductivity
• elasto-plastic analysis
• magnetohydrodynamics
• System identification and modelling
• Plasma modelling for engineering application
• Thermal fatigue
• High heat flux thermal fatigue
• Failure Mode Effects Analysis
• ANSYS
• ABAQUS
• MCPN

24 - Design codes and standards,
• Industrial codes and standards
• Nuclear codes and standards
25 – Nuclear Safety, Licensing and Protection of nuclear installations and devices

- Radiation Protection techniques
- Radiation Protection regulation
- Radiation shielding
- Nuclear hazards
- HAZOP
- OSHA
- Decommissioning
- Radwaste management
- Radwaste disposal
- Beryllium waste management
- Radiological monitoring
- Environmental monitoring
- Probabilistic safety analysis
- Deterministic safety analysis
- Best estimate safety analysis
- Conservative safety analysis
- Transient analyses
- Accident sequences analysis
- Advanced computer simulation for accident analyses
- Safety Follow-Up on Nuclear Procurements
- Nuclear facility licensing (Technical expertise)
- Beryllium handling & safety
- Airborne radioactive contamination confinement
- Radiation Shielding Calculations
- Dose Release Calculations
- French Nuclear Safety Regulations (support to analysis, inspection, training, etc.)

26 - Conventional (non-nuclear) Health and safety

- French Health & Safety legislation
- Italian Health & Safety legislation (DL 81/2008)
- German Health & Safety legislation
- Hydrogen handling: ATEX application to H2 handling
- Hydrogen handling: risk assessment techniques
- Non-nuclear hazards

27 - Materials testing (destructive, non-destructive)

- Destructive tests
• Non-destructive tests
• Post irradiation tests
• Definition of UT examination procedures
• UT level 3 (certificated) for 60 mm Stainless Steel
• Analysis of UT results in relation with codes and standards
• RX examination procedures and interpretation of defects on 60 mm Stainless Steel
• Digital radiography
• Material testing at cryogenic temperatures

28 - Mechanical fabrication and Joining techniques
• Technologies of fabrication
• Standard manufacturing and joining processes (and simulation)
• Boiler production with thick (60mm) Stainless Steel
• Large Bellows design (>1m diameter)
• Bellows for nuclear application
• High precision machining
• Machining of large scale components
• Laser Sintering
• Electron Beam Sintering
• Additive manufacturing technologies
• Welding techniques
• EB welding
• TIG welding
• laser welding
• Arc welding processes
• Friction welding processes
• Brazing processes
• Hot Isostatic Pressing (HIP)
• Powder HIP
• HIP of heterogeneous materials
• Diffusion bonding
• EB and TIG welding shrinkage analysis on thick (60mm) Stainless Steel
• EB and TIG welding process qualification (WPS, WPQR) on Stainless Steel
• Explosion bonding
• WPS
• fitting of pieces
• field interaction knowledge
• Brazing (Metallic, Bi-metallic structures and Non-metallic to metallic structures)
• Heat treatment
• Surface treatment (metallic components)
• CNC machining
• Computer aided manufacturing (CAM)
• CMM (coordinate measuring machine)
• Beryllium manufacturing (fabrication, machining, handling and safety)
• Codes and standards related to joining and non-destructive testing

29 – Assembly, Installation, Validation and testing
- Assembly of complex and large equipment
- Manipulator aided assembly
- Assembly of high vacuum components
- Assembly of optical components
- Acceptance tests
- Vacuum testing
- Pressure testing (including hydraulic and thermo-hydraulic)
- EB test facilities operation and commissioning
- Simulation analysis and product assembly studies
- Assembly/Installation Documentation Management (SmartPlant)

30 - METROLOGY
- Geometrical survey
- Tolerance analysis
- Spatial Analyser
- Polyworks
- Metrology simulation
- Metrology plans
- Reverse Engineering
- Virtual Assembly

31 - Plasma Engineering
- Plasma engineering (component design verification, engineering of scenarios, plant integration)
- Plasma-Wall interaction (normal, transient and off-normal events)
- Plasma Operations (Tokamak operation, Operational limits, plasma commissioning)
- Plasma Scenario simulation (1D, 2D simulations, integrated modelling)
- Plasma modelling (transport, MHD, plasma edge physics, fast ion physics, runaways, etc)
- Heating and Current drive physics and modelling (including NTMs)
- Plasma fuelling and pumping
- Disruptions

32 - Tokamak mm-waves launchers
- mm-wave engineering
- mm-wave component design and testing
- mm-wave special components (such as windows, tapers, waveguides, etc.)
- mm-wave transmission (guided and quasi-optical)
- electro-magnetic aspects of mm-wave transmission (HEmn, TEMoo, specific modelling)
- mm-wave specific diagnostics (ECE, IR, component-specific diagnostics for ITER)

33 – Tokamak Ion Cyclotron Heating (ICH) antenna
- ICH engineering
- Electrical engineering for high power ICH antennas
- Brazing of metallic/non-metallic materials
- ICH wave transmission
• ICH special components
• ICH antenna control and protection
• ICH specific diagnostics (arc detection, reflectometry, component-specific diagnostics for ITER)
• ICH operation with fusion plasmas
• ICH physics
• Mechanical analysis
• Seismic analysis

34 - TOKAMAK and PLASMA Control System Engineering
• Tokamak plasma control (experience in design and/or operation of plasma control systems in a tokamak)
• Additional Heating Control (Experience in design and/or operation of additional heating system in a fusion device, including Neutral beams, Ion Cyclotron, Elevation Cyclotron and Lower Hybrid system)
• Tokamak control, operation and protection (Experience in design and/or operation of systems for the management of safe and efficient tokamak operation)

35 – Superconductivity and Superconductor Magnets
• Superconducting material
• Superconductor Magnet design and technology
• Superconductor cable and conductors production
• Superconductor cable and conductors test
• Magnet design
• Manufacturing of Superconducting coils (winding / impregnation)
• Testing of Superconducting coils (warm and cold testing)
• Cryogenics design and technology applied to magnet cooling and stabilization

36 - Information Communication Technologies
• SQL, PL/SQL Programming, stored procedures, functions, triggers and database development
• Oracle databases: Programming, stored procedures, functions, triggers and database development
• Automation of manual processes
• SQL performance and Tuning
• ETL processes
• Database documentation management (development)
• SharePoint data bases
• Continuous integration, continuous delivery

37 – Measurement Systems
• Requirements specification
• Engineering
• Design
• Manufacture
• Sensors
38 - Industrial Intelligence
- Financial assessment and evaluation of companies
- Commodity markets
- International (non-European) industrial markets
- International (non-European) financial markets
- Economic and impact analysis of large projects
- Market survey methods
- Financial planning and analysis
- Budgeting and forecasting
- Probabilistic forecasting

39 - Accelerator related technology:
- High power, high intensity linear accelerators engineering
- CW high intensity ion sources (ECR sources)
- RF cavities development (RFQ, superconducting cavities)
- RF systems
- High power beam transport lines
- Beam diagnostics
- Beam Dynamics
- Control system
- Machine protection system
- Radioprotection system
- Accelerator commissioning

40 - Insurance Services
- Decennial insurance
- Third party liability insurance
- Nuclear insurance
- Construction insurance
- Others

41 – Communication
- Science Communication
- External Communication strategy
- Stakeholder engagement and communication
- Internal Communication
- Social media strategy and application
- Website analysis and development