**Appendix No. 2 –Technical Requirements for the AFP System**

**Technical requirements for Automated Fibre Placement (AFP) system:**

The general description of the System:

The subject of the order is a system for automated composite tape laying on a mould. The system is designed for laying pre-impregnated, thermoset, thermoplastic glass and carbon fibre tapes. The system needs to be capable to lay unsaturated (dry fibre) tapes.

1. **The system should be composed of:**
   1. Composite tape laying head:
      1. It should be able to lay tapes of standard width: 0.25in,
      2. It should be able to lay carbon and glass fibre-reinforced tapes,
      3. It should be able to lay thermoset, thermoplastic saturated tapes
      4. It should be able to lay 8 of 0.25 in width tapes of thermoset material during single head feed,
      5. It should have heating device to be able to lay 4 of 0.25 in width tapes of thermoplastic material,
      6. Head should have thermal sensor or thermal camera installed to control temperature of heating thermoplastic material,
      7. It should be able to place tapes in the distance between separate tapes not larger than 2 mm,
      8. It should be able to place tapes on cylinder-shaped concave moulds with local radius/curvature of 310 mm,
      9. It should be able to place layers on sandwich structure at the angle of ramps at least 200,
      10. It should be able to program/control the head/roller onto a mould pressure, to allow laying tapes on Nomex core structures without any damage to the core,
      11. It should be able to cut tapes as set by the composite tape laying programme,
      12. In case of laying several tapes in parallel, the head must cut each tape separately.
   2. Mechanical device that moves the head in space, e.g. a robotic arm:
      1. The range of movement should be set to build flat composite parts of size 1.5m x 4m,
   3. Tape/fabric roller feeding and holding system:
      1. It should be able to feed a number of tapes and width of tapes adjusted for the head work,
      2. It should be able to stop the machine work when a tape tears off, has finished or in case of tape jam.
      3. It should have a function for manual feeding a new tape to the head
   4. Heating system:
      1. It should allow in-situ production of parts using continuous fibre reinforced thermoplastic tapes.
   5. Software that allows for layering composite material according to definition of layers:
      1. It should control the system to lay composite material according to composite definition
      2. It should be able to operate independently as a "standalone” software installed on one selected PC,
      3. It should be able to import a composite definition from the Catia CPD and Fibersim software,
      4. It should be able to define tape paths according to defined via Catia CPD and Fibersim model ply boundary and direction,
      5. It should be able to export ply definition to Laser Projection System
      6. It should be able to program the automated layer placement system according to a set definition of a composite, mould geometry and set process parameters,
      7. It should be able to analyse accuracy of tape laying,
      8. It should be able to simulate a tape laying path,
      9. It should be able to optimise tape laying,
      10. It should simulate kinematics of a head with the head moving device for verification of movement accuracy, process time,
      11. It should simulate complete system kinematic to prevent and avoid collision.
   6. System control panel:
      1. The system should include a stationary control panel based on PC and a mobile control panel,
      2. The stationary control panel should provide full system control and operation,
      3. The mobile control panel should perform checks and modifications of standard functions and settings of the tape laying system,
      4. The stationary control panel should display current parameters of the system work,
      5. The stationary control panel should have an interface, e.g. a keyboard and mouse that are used for programming the system and modifying work parameters,
      6. Both panels should be equipped with a button marked in red that immediately stops and shuts off the system,
      7. The stationary control panel should be connectible to the computer network and should exchange data through the computer network,
      8. The stationary control panel should allow for performing online remote diagnostics by the machine's supplier.
2. **The system expandability**
   1. The system should be modular, there should be an option to expand the system with mould/mandrel rotation system that allows production of axially symmetrical parts.
3. **Safety**
   1. Supplier will deliver, install and verify required safety controls i.e. emergency stop, door lock.
4. **Additional requirements**
   1. The system should hold certificate of conformity CE, or equivalent,
   2. Supplier will grant 12 months warranty for the system starting on the date of the final acceptance
   3. Within warranty period, supplier will provide telephone technical support and on line diagnostic available every business day
   4. Within warranty period, supplier will repair malfunction parts within 2 working weeks, starting on the date of malfunction report,
   5. Supplier, in cooperation with customer, will prepare system layout study. Supplier will deliver drawing with location and definition of required for the System installation electrical and pneumatic wiring.
   6. The system should be supplied, installed and launched by a supplier,
   7. The system sold within the order should be complete, operative and allowing production of sample composite parts after it has been installed,
   8. The system's manufacturer will train personnel in the scope of software and system operation,
   9. The system's price should include all costs, i.e. the cost of all sub-assemblies, software, installations and personnel training,
   10. As part of an order, a supplier should supply consumable and operational material stocks for the term of the warranty,
   11. Supplier will deliver, assemble and launch the system within 12 months from the date of signing a contract.