TERMS OF REFERENCES FOR RESEARCH PROJECT

1. TITLE : Study for the Design, Construction, and Performance Requirements of Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES) for Oil-Filled Transformers

Sectional Committee : Fire Fighting Sectional Committee, CED 22

2. BACKGROUND:

During normal operation, electricity transformers experience a gradual increase in oil temperature. In extreme conditions of severe heat build-up, the oil can reach super-heated levels, posing a significant risk of fires and explosions. These incidents not only lead to the destruction of the transformer itself but can also trigger fires in nearby transformers. To address this critical issue, a comprehensive study is essential to establish design parameters for the effective implementation of the Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES), aimed at mitigating these potentially catastrophic risks.

3. OBJECTIVE

The objective of the study to collect the data/information from primary and secondary sources for design, construction, and performance requirements of Nitrogen Injection Fire Prevention and Extinguishing System (NIFPES) for oil-filled transformers.

4. SCOPE OF THE PROJECT

The scope of the project is multifaceted, aiming for a comprehensive understanding of Nitrogen Injection Fire Prevention and Extinguishing System for Oil-Filled Transformers of 10 MVA and above or minimum 2000 litres of oil capacity. The project encompasses the following key elements:

4.1. Literature Review:

- Undertake an extensive and intensive examination of the available literature on the subject.
- Include a review of international standards, if any, pertaining to Nitrogen Injection Fire Prevention and Extinguishing Systems.
- Analyse research papers published on the subject, studies conducted by industry or organizations, and any other relevant literature.

4.2. Import/Export Analysis:

- Scrutinize the import/export dynamics of NIFPES.
- Investigate the technical regulations governing the product in countries with significant export/import activity.

4.3. Manufacturing Base:

- Study and compile data on the manufacturing base of in India, covering production processes, facilities, and distribution networks.
- Gather insights into production capacities, technological capabilities, regulatory compliance, and market dynamics within the Indian context.

4.4. Feedback:

- Develop a structured questionnaire to get feedback with major importers, exporters, NIFPES manufacturers, transformer manufacturers, end users, and laboratories.
- Conduct interviews to collect first-hand information on the practical aspects, and challenges.

4.5. Visits to Manufacturers and End Users:

- Conduct visits to manufacturers of NIFPES, transformer, and the end users, covering a spectrum from large-scale to medium and micro-level manufacturers.
- Identify and document the diverse manufacturing processes employed for the product.
- Investigate and catalogue the testing facilities within the country related to electric transformer fire protection systems.

4.6. Labs Visit:

- Visit laboratories specializing in electric transformer fire safety to gain insights into ongoing research, testing methodologies, and innovative approaches.
- Document the technological advancements and best practices observed during lab visits.

4.7. Data Analysis:

- Analyse the data collected from the literature review, NIFPES manufacturer' visits, end users, import/export analysis, lab visits, and interviews.
- Identify patterns, trends, and critical insights relevant to the effectiveness and implementation of Nitrogen Injection Fire Prevention and Extinguishing Systems.

5. METHODOLOGY:

In respect of the areas covered under the scope, the methodology encompasses the following:

5.1. Review the literature as specified under the Scope.

5.2. Prepare the report on manufacturing base, import/export dynamics of NIFPES in India.

5.3. Preparation of the questionnaire and share the same with major importers, exporters, NIFPES manufacturers, transformer manufacturers, end users, and laboratories to get the feedback.

5.4. Visit the three manufacturers of NIFPES (large, medium, and small), two manufacturers of transformers, and three End Users (large, medium, and small) of NIFPES to collect the data. During the visit, data shall be collected for the following:

- Processes and practices employed by utilities (end users), transformer manufacturers, and NIFPS original equipment manufacturers for fire prevention and protection. This includes examination of methods for detection, depressurization, and injection.
- System installation testing and simulation test procedures at site.
- End users views regarding supply, delivery, installation and maintenance processes and practices.
- Witness the testing of the system as NIFPES manufacturer's work.
- Raw materials used in the manufacturing of the system.
- In house quality control requirements of the raw materials.
- Manufacturing methodologies.
- In process quality control and its data during manufacturing.
- Sustainability efforts being used by the manufacturer with respect to Reduce, Reuse, and Recycle.

5.5. Visit two laboratories to witness the testing of the system. During the visit data shall be collected for following:

- Testing of the various performance parameters of the system.
- Testing methodologies used.
- Perform a comparative analysis of the methodologies used in different labs/NIFPES manufacturer's work to identify variations and best practices.

5.6. Analyse the data as specified in the Scope. The data analysis shall encompass the following:

- Maximum operation time for total system.

- System initiation time.
- The quantity and rate of oil to be drained for different rating and oil capacity of transformers.
- The purity and quantity of nitrogen injection, injection rate, and discharge pressure for different rating and oil capacity of transformers.
- Design engineering and calculations need to be carried out for the following pertaining to different rating and oil capacity of transformers:
    - Pipe size and location for oil drain line.
    - Pipe size and location for nitrogen injection.
    - Operating time of Transformer Conservator Isolation Valve (TCIV).
    - Appropriate failsafe designs of automatic oil drain valve, nitrogen release valve, and interlocking.
    - Indicative early detection and operational logic.
    - Effectiveness, limitations, and shortcomings of the NIFPES.

NOTE — All design criteria should be supported by calculations, formulae, numerical values, and drawings/illustrations for ease of understanding.

6. DELIVERABLES

Considering the scope and objectives, the research shall be taken up by the proposer and prepare a report on the following deliverables:

- Project report covering all the aspects of the Scope.
- Questionnaire, feedback, and test reports shall be appended to the project report.

7. TIMELINE AND DELIVERY MILESTONES

The timeline of the project shall start from the date of issue of sanction letter by BIS. The details are as follows:

Stage	Timeline
Report on the literature review, manufacturing base, import/export dynamics, questionnaire, and feedback.	4 weeks
Report detailing visits to NIFPES manufacturers, transformer manufacturers, end-users, and laboratories and documentation of interviews conducted during the visits to acquire firsthand information. Submission of interim report to Sectional Committee at the end of the third month.	12 weeks
Review of the interim report by the Sectional Committee and feedback.	14 weeks

Stage	Timeline
Draft final report submission.	18 weeks
Review of the draft final report by the Sectional Committee and feedback by the Sectional Committee.	20 weeks
Final comprehensive report submission including the feedback from the Sectional Committee.	22 weeks
NOTE — In case of delay in submission of final report, the justification shall be given by the awardee for consideration by the Sectional Committee.	

8. SUPPORT FROM BIS

a) To provide any National/ International standards.

b) Licensee details of manufacturers of similar products.

c) List of BIS approved laboratories for testing similar products.

9. NODAL PERSON

Rajesh Choudhary

Assistant Director/Scientist B

Civil Engineering Department

Phone:+91-11 2360 8590

Email: r.choudhary@bis.gov.in

****