Format for uploading details of completed projects

1. **Project details**
   a. *Title*: **Design of Cascaded Adaptive Control with O_2 and Temperature data of Combustion Images for Optimization of Boiler Combustion Processes in a Thermal Power Plant.**
   b. *Institute*:
   Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology,
   Avadi, Chennai, Tamilnadu, India – 600 062.

2. **Aim / Objectives:**

The main objective of this proposal is to attain optimized, smooth and fast response of combustion process in a Thermal Power Plant by

1. Optimizing air and fuel flow control based on combustion flame image and adaptive control is proposed.

- Combustion flame temperature of a thermal power plant will be measured from combustion flame images in LabVIEW software by using wavelet transformation technique, clustering through Fuzzy K means algorithm, defining temporal trends by DFT (Discrete Fourier Transform) and ANN (Artificial Neural Network) for decision making.
- Adaptive control model for fuel and air will be developed in this proposal along with combustion flame image for optimization in air and fuel flow.

2. Validating and analyzing the performances in comparison of conventional combustion control mode with the proposed mode of optimized combustion air and fuel control design.

- First validating the performance of fabricated lab scale mimic panel in conventional combustion control mode based on the thermal power plant data and its characteristics.
- Next proposed scheme, combustion flame image and adaptive based combustion air and fuel control design will be performed in the fabricated lab scale mimic panel.
- Finally analyzing by comparison in performances of conventional control method and the proposed optimized scheme will be executed.

3. **Executive Summary (*One page*):**

In thermal power plants **the goal of the boiler combustion processes is to keep the combustor in optimal condition and lower instabilities. Conventional combustion control systems for furnaces depend on simplified flame temperature measurement schemes and monitoring of excess O_2, CO, CO_2, NO_x and SO emissions. Moreover, the biggest problem in the conventional control strategies is that control systems based on the oxygen content come in with a certain delay that causes final product loss.** When the disturbances such as a change in the inlet air flow or fuel flow rate entering the combustor, it will affect the outlet oxygen content of the flue gas. Although oxygen content in the flue gas can be easily measured **by gas analyzers, the measurement results obtained in this way are significantly delayed**. **It often takes few minutes to get responses.** With so many lags in the present system, it will take a considerable amount of time for the control loop to detect a change in the oxygen content in flue gas. Because of these lags, the feedback control loop based on the simple oxygen content in flue gas will tend to overcompensate, results in sluggishness and slow control.

Whereas **online measurement of combustion temperature from flame images will immediately reflect the current status of the combustors. Combining combustion flame image and adaptive (Energy Balance model) for optimized air-fuel combustion control of a boiler in a thermal power plant is a novel approach and it is proposed.**

Physical flame characteristics, i.e. its geometric (size & location) **and luminous** (brightness and uniformity) **parameters, temperature distribution or its oscillation** (flicker) **frequency,** provide detailed information about combustion efficiency and stability, which can be **used to develop optimization strategies of monitoring and control algorithms.** According to the brightness value of flame image pixels, the combustion characteristic parameters can be picked up from the flame image. The online monitoring of combustion quality using intelligent image processing technique will be performed by LabVIEW software and **thereby automatic adjustment of air-fuel ratio will be achieved so as to ensure complete combustion.**

Optimization will be performed by combustion images and adaptive control model for air and fuel control in a Thermal power plant. Finally, the **outcome of proposed innovative technique is that it will perform optimized, smooth and quick response in air and fuel combustion control for balancing the load demand without delay thereby tripping of boiler and turbine will be avoided. In sequence boiler**

thermal efficiency of thermal power plant will be increased in terms of raise in turbine steam pressure and temperature for its load demand.

4. Scope for further work

LabVIEW and MATLAB codes used in this proposed research work must be embedded in an IC chip for speedy computation of boiler combustion videos in getting temperature and its actual fuel flow rate.

This proposed research work is performed in mimic lab scale set up.
Validation is performed from the data collected from NLC TPS-Expn, Neyveli.

Further need to validate in BHEL, Trichy which will be better for implementation of the proposed research work in Thermal power stations

5. Benefits visualized

The expected deliverables of the research study are specified and its importance to the present-day needs of the power sector is correlated to bring out the relevance and importance of the work to the power sector.

- Fuel can be saved by optimizing fuel flow and hence cost will be reduced.
- Performance of the entire plant will be improved.
- Life of Boiler, Turbine, Generator and Control valves will be increased
- Load disturbance due to grid frequency variation will be controlled in a smoother way.
- Tripping of boiler, turbine and generator will be avoided.
- Consequently, power cut will be completely avoided to Indian power sector/ Indian utility/ Manufacturer/ Society and as reflection there will be increase in profit in all sectors.