ARTIFICIAL INTELLIGENT BASED SHOOT BLOWING DESIGN ON NEW MODE OF POWER GENERATION

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***Abstract*— Currently thermal power plant has many more challenges with respect to its generation in best possible and efficient way. Hence, sustainability of power plant now a day's highly depends on adaption of optimal availed technology focusing on effective individual operation. The present work focusses on one of the shortcoming of the existing model i.e., indirect losses station called as blow down operation. The primary merit of the current work is to optimize shoot blowing and its utilization to enhance overall power plant efficiency which is achieved by effective data preparation. The empirical simulation emphasizes a better model of intelligent soot blowing structure. At present almost the power plant follow-up the time scheduling process for blowing, which causes many excessive losses and decrease operation potentiality. The current work proposes an Artificial intelligent based system adaption for soot blowing optimization. Since fuzzy technique has the capability of tolerance of impression, uncertainty and robustness with low-cost designing. Hence, the proposed fuzzy- AI tools is demonstrated to be better for cleaning of individual and corresponding soot blowing process. Thus, thereby improves boiler efficiency through improving operational behavior by reducing NOX emission, also the activity of soot blower.**

Keywords— Intelligence process, smart devices, AI- Fuzzy system, linguistic variable Power plant, Soot Blowing

I. INTRODUCTION

During combustion, the deposited element which reduce heat transform is the major impediment for achieving higher efficiency of the operation of a traditional boiler. To operate boiler targeting higher efficiency, the cleaning of boiler surface periodically with proper principle and process i.e., soot blowing is crucial [17]. The deposited element during combustion process basically reduces the heat transfer. Hence, the lower heat transfer capability declines the overall efficiency of thermal power plant. Hence, to circumvent this situation, soot blowing is adapted in regular time interval for cleaning the surface which increases heat transfer capability of the exposed surface where there are chances of depositing ash [18]. To improve the efficiency of a power plant, an intelligent and smart shoot going technique which abets to optimize the process of steam generation is paramount. In this regard, a system that can monitor different power plant real time data for regulating the soot blowing on when and where if highly indispensable. Unlike the traditional system where soot blowing offers at regular pre-defined interval and throughout the exposed surface even though it is required or not. The proposed intelligent soot blowing activates at required movement and necessary area of exposed surface such that the operational cost and system management support is much improved increasing its efficiency [18,19]. The main objective of the proposed smart soot blowing is to lessen the utilization of steam which can be reutilized for other required process in power generation system. Theory states that minimizing indirect loss which is a key factor can improve the operational efficiency. Hence in the proposed model a fuzzy system based logical designing supported with linguistic experience useful to not only clean the entire exposed surface but also focuses on the affected heat transfer area covered due to ash depositing. Thus, the proposed model facilitates for the optimal use of de-super heater sprayer for lowering fluid gas temperature passing towards exist end of boiler [15,16].

II. METHODOLOGY

The proposed work focusses on the linguistic experience based logically designed non-crypts input of boiler parameter to provide a successful model where cleanness factor is a primary parameter to continue the shoot blowing activities. The cleanness factor basically is the ratio of actual heat transfer rate to the designed heat transfer rate, concerned to requirement of cleanness through soot blowing process.
The proposed methodology elaborates the process of intelligent soot blowing through the following sequence of operations.

- Preparation of data and system of collection.
- Analysis of the system with new set of data.
- Advisory tools for practical modelling.
- Data preparation and collection.

On closely studying the corresponding characteristics, it is observed that the individual data has the primary role in the data collection and preparation process. To observe the data, simulation is essential on specified data group. Hence, necessary data is collected from the possible section of the power plant related to heat utilization on steam generation. The fuzzy system modeling generally comprises of fuzzy set, fuzzy variable, and fuzzy rules and is implemented on a single platform of operation with the available data set. A function that provides membership value for fuzzy variable are mostly within the range of (0,1). The common relationship between the input and output condition and parameter are expressed by the fuzzy rules. It mostly takes the support of experience, exposure and expertise of the person concerned in the mode of linguistic expression. Based on the above process the fuzzy system device has three different soft units0 as shown in Fig.1.

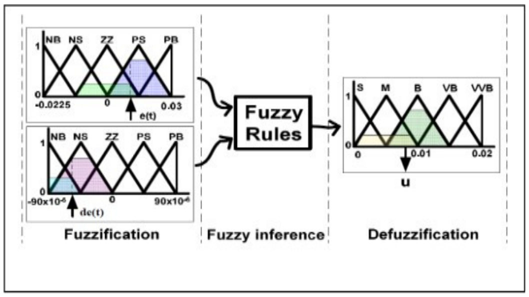

Fig. 1 Basic block diagram of fuzzy system

Fuzzified, Fuzzy rules based on the de-fuzification are commonly used three sub rules of fuzzy logic controller. The Fuzzy fire converts the crypts input parameter in to fuzzy nature which the system can understand. The inference engine is the main component and responsible for all logical manipulation and relationship expressing. The resultant of fuzzy inference system is in the fuzzy form and it needs to be converted into crypts nature so a d-fuzzified is attached as in the system block diagram of the proposed model in Fig. 1. In this fuzzy modeling of intelligent soot blowing monitoring Mamdani type FIS is considered and d-fuzzyfication process is computed by centroid method.

III. THE PROPOSED MODEL DESIGNING

This smart linguistic command based intelligent model defines and determines the cleanness factor of the furnace which should be optimized to maintain overall efficiency of the broiler. The following are the parameters abetting to intelligent soot blowing modelling which are directly associated to maintain the cleanness factor.

- Temperature of metal plate.
- Flow rate of steam.
- Angle of the burner movement (burner tilt)
- Associate mills.
- Present load.
- Soot blowing exposes time.

Considering the parameter mentioned above in the linguistic form during real time observation, condition and situation as below.

- Low, average, high (L, A,H)
- Low, normal, high (L,N,H) = temperature in degree centigrade.
- Low, normal, high (LNH) = Spray
- Down, Normal, Up (DNU) = Burner Tilt
- Lower, Other, UP = combination of the Mill
- Short, average, long = time

TABLE I. The parameters in the linguistic form

Gaussian MF	**Spray**	**Ranges**
Low	L	[20,40]
Normal	N	[25,55]
High	H	[40,60]
Gaussian MF	Burner Tilt	
Down	D	[-30,0]
Normal	N	[-20,20]
Up	U	[0,30]
Gaussian MF	Mill Combination	
Lower	L	[0, 0.5]
Other	O	[0.1, 0.9]
Upper	U	[0.5,1]
Bell MF	Time since last SB	
Short	S	[0,4]
Average	A	[2,18]
Long	L	[10,24]
Bell MF	Cleanliness Factor	
Dirty	D	[0,82]
Clean	C	[70,100]

Table 1 represents the membership function and range of all parameters of the fuzzy system. Let the command output (co) be the objective function and here cleanness factor (CF) be the command output in % which is the condition of surface i.e. dirty/clean.

TABLE 2. Linguistic variable for all input output parameter in linguistics form

Linguistic Value	**Notation**	**Ranges**
Gaussian MF	LOAD	
Low	L	[450,480]
Average	A	[470,500]
High	H	[490,520]
Bell MF	LSH Temperature	
Low	L	[520,530]
Normal	N	[530,540]
High	H	[540,550]

Table 2 indicates the parameter in linguistic form. The six input variables (LOAD, TEMP, SPRAY, TILT, MILL, COMB, TIME) and one output variable (CF) as explained in above process can be represented in fuzzy technique of designing depicted below.

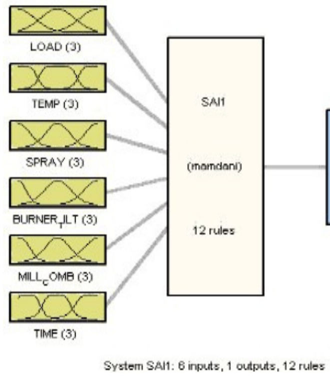

Fig. 2 Input output relationship with membership function

Fig. 2 represents all six input and output variables with its membership nature.

Rule	Load	Temp	Spray	Tilt	Mill Com	`Time	Out put	Commd
1	Lo	Lo	Lo	Nor	Lower	Lo	Clean	0
2	Lo	Hi	Hi	Down	Upper	Hi	Dirty	1
3	Avg	Nor	Nor	nor	other	Avg	Clean	0
4	Avg	Hi	Hi	Down	other	Hi	Dirty	1
5	Hi	Lo	Lo	Nor	Upper	Avg	Clean	0
6	Hi	Hi	Hi	Down	Other	Hi	Dirty	1
7	Hi	Hi	Nor	No	Upper	Avg	Clean	0

Fig. 3 statement of rule based i.e. the condition and relationship of parameter

Fig. 3 specifies the statement of rule based i.e. the condition and relationship of parameter express for all possible state of designing system of soot blowing.

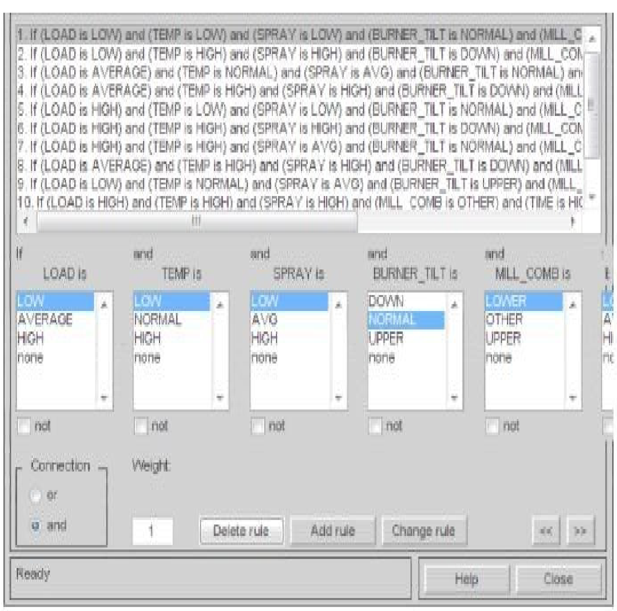

Fig. 4 Fuzzy ruler expressing condition and relationship on operation

Figures 5, 6, and 7 represents load and corresponding spray for output (CF) and set of six input relationship interns of surface view. The surface view represents optimized value of CF.

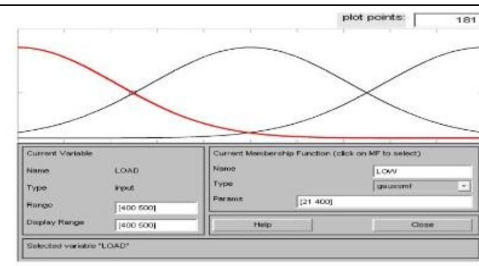

Fig.5 LOAD MF

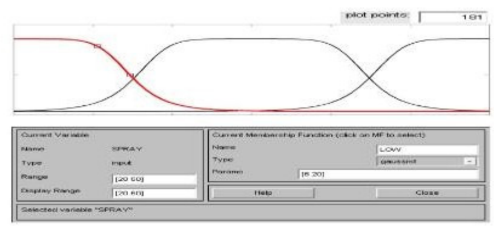

Fig. 6 SPRAY MF

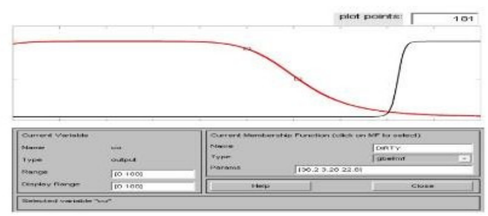

Fig. 7 OUTPUT (CF)

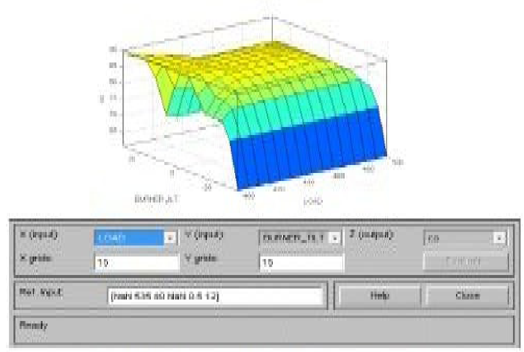

Fig. 8 Surface view of Load, Burner tilt and CO

IV. ANALYSIS AND MODELLING FUZZY BASED SYSTEM

The most important phase of the current work is modelling. Based upon on fuzzy inference mechanism the corresponding result of aggregation has been developed. That will defuzzufied for aggregate output which leads to designing optimal operation. The proposed model designing is direct application of FIS system. This observation of the output value in crips nature for corresponding fuzzy input or crips to fuzzy mechanism. The observation on the model and analysis of process demonstrates its novelty towards fulfilling required objective of this work. It provides minimal possible operation and maintenance cost while maximizing power generation and offers safety from misutilisation of shoot blowing process. Table 3 provides designing data for the proposed model.

TABLE 3. Estimation of the cleanliness

Load MW	SH temp	Spray	Burner tilt	Mill com	Time Hr	CF%
490	540	20	-15	0.5	15	89.3
493	545	25	-15	0	24	87.3
492	529	35	-10	0	24	51.1
494	545	30	10	1	22	89.7
497	546	30	0	1	20	91
499	525	50	-15	.6	25	48.2
489	530	20	30	0	22	69.8

Results:

Enter LOAD: (MW): 490

Enter SH METAL TEMP: (C): 540

Enter TOTAL SPRAY: (T/H): 20

Enter BURNER TILT : (degree): -15

Enter MILL COMBINATION: 0.5

Enter TIME SINCE LAST S/B: 15

CLEANLINESS FACTOR OF THE FURNACE is 89.335727

V. THE PROPOSED TOOL

TheAI- fuzzy base outcome module is shown in figure. This proposed model gives a suitable operation on interval of soot blowing. Once the total output of individual parameter has been analysed by fuzzy system supported with well-defined fuzzy rules and conditions. Hence, the outcome of the proposed model designed with thisAI- fuzzy principle and technology operate soot blowing in higher effective mode. During the operation if any lagging and mismatch of parameter occurs, then the corresponding controller back signal automatically follows the optimization of fuzzy system due to earlier well defined fuzzy rules and conditions. In the Fig. 9 represents complete optimization of soot blowing and modernizing the power plant for higher order operation. The complete process continues until the deviation of plant andAI- fuzzy model error margin becomes zero. This concept of operation provides soot blowing more purposeful and fruitful towards enhancing of boiler efficiency higher.

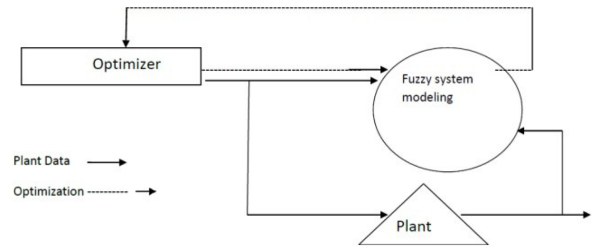

Fig. 9 The proposed intelligent soot blowing

VI. CONCLUSIONS

In the current work, a AI-fuzzy system for soot blowing optimization is proposed. TheAI- fuzzy technique is adopted extensively due to the tolerance of impression, uncertainty and robustness with low-cost designing. The proposed AI based model is demonstrated to be efficient in designing and modelling intelligent soot blower and is shown to be better for cleaning of individual and corresponding soot blowing process. This is achieved by improving the lagging behind regular time interval soot blowing. Moreover, logical expression behind real time monitoring of soot blowing process augmented in achieving the efficiency. This is ascribed to the fact that the needs of soot blowing occurs by satisfying the behaviour cleanliness operation of the furnace which is a chief component of the power plant.

This notion can further be employed on different indirect heat losses domain in power plan to recover and improve efficiency of the overall plant. This process is quite adaptive to all possible segments to minimize indirect heat losses because of its linguistic description of the problem and can be restructured into appropriate numeric data which the digital device needs for smart computing that abets in effective blow down process. Apparently, an attempt to design a model based on human expertise experience into optimal technology form is made in the proposed work.

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