Water Efficiency Management Strategies in Electric Engineering Generation Industries: an Epilogue

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Abstract: ***The impending jeopardies relating to dearth of water in performing the techno economic activity of production of electricity in power industries ushered gainful insights for this research paper for pursuing to reckon and quantify the renewable electric energy consumption of water by gauging at the foot prints. This research paper presses the need of the hour to persistently stimulate the electric generation industries to integrate the multidimensional anomalies of seasonal changes of monsoonal fresh water in the arena of Environmental micro and macro climate strategies. Taking cue of electric energy water sequential linkages using water foot printing technology this paper empirically estimated that, minimum water foot print was recorded in selected biomass and natural gas based electricity producing industries to yield 1000 kilowatt of electricity vis-à-vis selected Hydel power station, which has voracious appetite. This research has been performed with a field level investigation of assessing the magnitude of water scarcity by performing a documentation of exemplary investigative case study approach in selected regions of Andhra Pradesh.***

Key words: Seasonal Erraticism, Biomass model, water footprint.

I. INTRODUCTION

The enormous diminution of water by intermittent vagaries of monsoons have led to intersectoral linkages among diverse sectors of an economy. Among them , within industrial sector electric thermal energy sector was adversely affected for the past one decade and this has been cumulative in the present era with undue exacerbation of minimal rainfall, prolonged dry spells, amassed over flow of water, acute and exorbitant temperatures. To maintain the efficacy of international standards of utilizing meager amounts of water to the level of 2.5 cubic meters of water in our Indian thermal power plants for 1000 kilowatt of thermal electricity production and a typical hydro power plant requires 6000 cubic meters of water per second for hydro electricity production. These water resource figures appears to be highly challenging task to realize within a short span of time in a commendable manner. In light of these hardcore realities and uncertainties, an effective problem-solving water productivity stratagems have been employed with emphasis on water resource efficient production of green electricity.

II. REVIEW OF LITERATURE

Various pertinent research works both at International level and National level has universally affixed a threshold limit of 10,000 m^3 /year to $\geq$ 1700 m^3 /year per region are characterized as water surplus and water adequate.

But to a matter of grave concern a decelerating trend has been exhibited in India. The practical possibility of links established by the eminent researchers owing to the strong relationship between the present percapita availability of water to the level of less than 1700 cubic meters to quote India as Water Stressed Country signposts for collective understanding of climate amiability. The level was universally estimated around 1545 cubic meters. The large seasonality variations of water resources were predicted to be unproductive with water levels of 1401 cubic meters and 1191 cubic meters by 2025 and 2050 respectively in future years channelizes India further in to most perilous circumstances. In this study, the continuous emission of danger signals of stooping low level of production in most of the water intensive thermal and hydel electricity production industries with sparsely availability of fresh water was highlighted with field level data statistics. The upshots of this study includes the relationship between judicious use of water in selected biomass and natural gas based power plant of India by counteracting the future perturbations inflicted by ravenous appetite of hydel power plants.

III. RESEARCH OBJECTIVES

- To understand the differences of water foot prints based upon the type of feed stock
- To assess the impact of water scarcity in Non-renewable Energy Power Stations

IV. RESEARCH DESIGN AND METHODOLOGICAL TOOLS

The research has employed a mixed method model for data collection that includes both quantitative and qualitative methods. Field level data was collected from selected one Hydel power plant namely Nagarjuna Sagar Main Power House in relative comparison with Natural Gas Based Power plant and Biomass Power Plant Limited. In-depth Interviews and Focused group discussions along with field survey methods were incorporated relating to performance assessment of various feedstock based power plants.

V. DATA ANALYSIS AND EMPIRICAL RESULTS

The approximation of electric energy water foot print encompasses a standard customary technique of summating all the process of water consumption for electricity generation at all its phases that includes for example steam generation, demineralized ultra-pure water, ash handling, cooling of heated generators and turbines and other related paraphernalia divided by total electric energy generation.

Revised Manuscript Received on October 15, 2019
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A clear bifurcation of climate zone in to four seasons has been made as summer (dry) , rainy (wet) , winter (cold) and post monsoon (medium wet) seasons has been made. A quite distinguishable fluctuating water resource utilization trend has been exhibited among selected Hydel, Biomass and Natural Gas based Power Plant.

Analysis of Empirical Quantification of Water Foot Prints in Varied Feedstock for Electricity Production.

The experiential quantification of Electric Energy Water Foot prints for three varied types of feedstock has been calculated using the operational gradient of Water foot printing technical knowhow.

Hydel Power Plant: Nagarjuna Sagar Main Power House

Table 1: Season Wise Water Foot prints in Nagarjuna Sagar Main Power House: Year 2005-06

Type of Season	Water Withdrawals Cubic Meters	Generation of Electric Energy in Million Units	Water Foot Prints in Cubic Meters
Summer	20270476800	151.5	133798.52
Rainy	13771555200	86	160694.92
Winter	57634934400	466.1	123653.58
Post Monsoon	106674278400	856.8	124503.12

The time horizon zone of four seasonal period clearly emphasizes the focal point that within hydel power stations the water foot print during rainy season was over heading the other seasons with the highest head count water foot print of 160694.92 cubic meters level, due to availability of abundant water. Contrariwise, the slack season of summer season was afflicted adversely with lower water foot print due to insufficiency of fresh water to the level of 133798.52 cubic meters. This had a bad repercussions of fall in short of production of electricity due to resource scantiness to the level of 151.5 Million Units.

Biomass Power Plant: Home Power Limited Company

Table 2: Season Wise Water Foot prints in Biomass Power plant: Year 2005-06

Type of Season	Water Withdrawals Cubic Meters	Generation of Electric Energy in Million Units	Water Foot Prints in Cubic Meters
Summer	146914	14954191.8	0.0098
Rainy	182028	20650631	0.0088
Winter	93816	15710445.1	0.0059
Post Monsoon	42110	9538655.3	0.0044

The water utilization for biomass power plant in electric energy production was quite impressive with the minimal recording of water foot prints to the level of point wise to the level of 0.0098, 0.0088, 0.0059, 0.0044 cubic meters across the four seasons of the year relatively with hydel power plants. This kind of exhibition of seasonality trend clearly signals that resource efficiency can be well maintained with utmost efficacy with biomass power plants.

Natural Gas Power Plant: Vijjeswaram Power Plant

Table 3: Season Wise Water Foot prints in Natural Gas Power plant Stage I: Year 2005-06

Type of Season	Water Withdrawals Cubic Meters	Generation of Electric Energy in Million Units	Water Foot Prints in Cubic Meters
Summer	1699	96	17.69
Rainy	3621	131.1	27.62
Winter	1403	3003	0.46
Post Monsoon	377	12.1	31.15

Natural gas as a feed stock for electricity generation uses water moderately with a countable water foot print of highest during rainy to the level of 27.62 cubic meters but during other seasons, the water utilization was very sparse due to shortage of fresh water.

This research paper pertinently emphasises the results by highlighting the use of green electric energy production using biomass as a fuel feed stock along with resource water efficiency. In a water constrained world, judicious utilization of resource is imperatively a dire need through game changing technological up gradations such as solar energy, wind energy and geothermal. The successful achievement of zero water foot print is the pressing immediate concern in electric generation industries by employing water efficiency management strategies through innovative technological breakthroughs.

VI. DISCUSSION

Documentation of Water Efficiency Strategies

Pump Mode Facility: To meet the fluctuating demand for electric energy during slack seasons, the gravitational pull latent of storing the seasonal water resource and pumping from low elevation level of dam to high elevation reservoir can be best water efficiency technique that is customarily followed in hydel electric power generating plants. This technique was followed by the selected hydel power plant to a remarkable extent

Induced Draft Cooling Technology: It is premeditated to accomplish positive output by optimal heat transmission and undeviating water circulation. This aids to conserve water engulfing for cooling the generators and counteracting the warm water discharge in to the rivers there by maintaining the ecological balance to certain extent in fragile areas. This type of technological breakthrough that has been evinced in selected biomass power plant and natural gas based power plant.

VII. CONCLUSION AND FUTURE SCOPE FOR RESEARCH

The reliability on zero water foot print technologies is pivotal for Global Environmental Sustainability of water resources. For this purpose the future research need to concentrate and emphasize not only on solar and wind energy that is more feasible in a rampant manner in only tropical rich countries. Much scope of research on pig poo that constitutes anaerobic bacteria that can be further fragmented in to organic matter that produce efficiently methane rich biogas. This feed stock can be used to operate biogas generators to produce electricity. Municipal solid waste on a landfill area can be ignited at a very high temperature of combustion and electricity can be generated Prevailing techniques for analytical and prurient bacteria's electrochemical activity encompasses mounting large consignments of cells and quantifying the activity of EET proteins — a duteous, laborious process.

ACKNOWLEDGMENT

My hearty thanks will be showered upon only one most revered Guru Late Dr. VBNS Madduri Sastri, MSC, Ph.D, Canada, who is a guiding soul for me in all my academic endeavors.

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