JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

ANALYSIS OF POWER SYSTEM DESIGN FAILURE

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Received: 24.01.2020 Revised: 19.02.2020 Accepted: 05.03.2020

ABSTRACT: Today, the electric power system comprises of complex interconnected network which are inclined to various issues that militate against the reliability of the power system. Lacking reliability in the power system causes issues, for example, high failure pace of power system establishments and customer equipment, transient and intransient faults, even faults and so forth. This paper gives a broad audit of the powers system and equipment reliability and related failure designs in equipment.As one of the country's generally intricate, large-scale networked systems, electric power has gotten progressively robotized in the previous three decades because of mechanical advances. Then again, these equivalent progresses have made new vulnerabilities to equipment failures, human mistakes, climate and other characteristic causes, and physical and digital assaults.

KEYWORDS: Power system design, Customer equipment.

DOI: http://dx.doi.org/10.31838/jcr.07.04.308

I. INTRODUCTION

Electric power systems are critical infrastructures similarly as gas and oil networks, water networks, transportation networks, telecommunications and computer systems. These complex networked systems are progressively reliant on one another, as the digital society develops on a worldwide scale. Subsequently, their weakness and security are raising significant concerns around the world. For example, the typical activity of water and telecommunications systems is kept up just if there is an enduring inventory of electrical vitality. Then again, the age and conveyance of electric power can't be guaranteed without arrangement to the power plants and power networks of fuel, water and different telecommunications and computer administrations for data transfer and control purposes. These interdependencies are fortifying their grasp as the use of the internet, intranet and other wide area computer networks is getting pervasive.

The solid dependence of critical infrastructures on one another may transform a neighborhood unsettling influence in one of them into an enormous scale disappointment by means of falling occasions, which may catastrophically affect the entire of society. Shockingly, the danger of such an appalling domino impact is developing in the USA in light of the flow pattern to work critical infrastructure systems closer to their dependability or limit limits. One convincing purpose behind this training is, obviously, financial matters. Furnishing these infrastructures with some level of heartiness includes some significant pitfalls, which involves the accomplishment of the necessary degree of excess in the hardware. This is even more valid since the extension of critical infrastructure systems doesn't keep pace with the fast development of interest.

A normal case of a critical infrastructure helplessness that experiences rising defenselessness to calamitous disappointment is the electric power transmission network. There are a few explanations behind such a circumstance to win. Right off the bat, as saw in created nations, including the USA, there has been a very moderate extension of the high voltage transmission framework during ongoing decades because of stringent guidelines set forward in light of natural concerns. Furthermore, there are the significant basic changes that the power business has set out on, which are intended for the rise and combination of focused vitality markets. In India, government organizations have given new guidelines to change the vertically incorporated utilities into free age, transmission, and dissemination organizations.

II. POWER DISTRIBUTION SYSTEMS

Power systems are one of the most perplexing infrastructures discovered worldwide and they are required to work with high caliber and reliability. The key motivation behind power systems is to give a financial and solid channel for electrical vitality to transfer from purposes of age to client areas. The monetary and reliability limitations can be commonly aggressive, making arranging and activity of power systems an unpredictable issue.

The dissemination system reliability assessment considers the capacity of the appropriation system to transfer vitality from mass stockpile focuses, for example, ordinary transmission system end-stations, and from nearby age focuses, to client loads. In the beginning times of broad power system development, generally less consideration was given to conveyance networks in light of their lower capital seriousness when contrasted with age and long separation transmission systems. Additionally, the blackouts in circulation networks are relied upon to have a restricted impact. In any case, investigation of down to earth utility disappointment registers and deficiency measurements uncovers that appropriation networks as a sub-segment of the power systems contribute the most to client interferences and disappointment occasions.

With progressions in innovations both incorporated in power systems and utilized in connection to it, a danger of increment in disappointment frequencies in power circulation segments is normal. Presentation and increments in system robotization, wide development in power request confusions because of conveyed age and so on. Are contributing components to this hazard these progressions are required to improve the exhibition of power system. Be that as it may, remembering that the additional segments are rarely impeccable, the option of a part which can experience disappointment subsequently presents an extra danger of disappointment in the system.

III.METHODOLOGY

The power systems operated by the utilities in developing countries sufferfrom large gap between the demand and generation, inadequate transmissioncapacity and non-uniform location of load centers and generating stations, powersector reforms in deregulation scenario made the power grid vulnerable to blackoutsdue to occurrences of critical failures in power systems.

Major power systembreakdowns have been occurring historically in the inter-connected electrical grids.Certain technical factors played an important role in the recently occurred criticalfailures.

Voltage instability.

Incorrect operation of protective system.

Critical overloads.

Frequency instability

Lack of supplementation of reactive resources to address the voltagecollapse.

Lack of control schemes to control rapid frequency decline following thedisturbance.

Lack of demand side and management techniques with automation to preventcascade failures.

Thus, the critical failures in the power system have presented challenges tothe power system planners and operators. This has made the study of critical failuresas an immediate need drawing the attention from the power system engineers andacademicians.

Thefrequency of the electricity produced by a synchronous generator is related to thespeed of the rotor and the number of poles in the stator as shown in equation (1).

$$f_e = \frac{n_m P}{120} \tag{1}$$

Where

fe : electric frequency (Hz)

nm : rotor speed(rev/Min),

P : number of poles

$$P[S=r]=\begin{cases} M_0\lambda(r\lambda)^{r-M_0-1}\dfrac{e^{-r\lambda}}{(r-M_0)!}; & M_0\le r<n \\ 1-\displaystyle\sum_{s=M_0}^{n-1} M_0\lambda(s\lambda)^{s-M_0-1}\dfrac{e^{-s\lambda}}{(s-M_0)!}; & r=n \end{cases} \tag{2}$$

Approximation of (3.1) for large r < n using Sterling's formula and a limitingexpression for an exponential yields

$$P[S=r]\approx\frac{M_0}{\sqrt{2\pi}}\lambda^{-M_0}r^{-1.5}e^{-r/r_0};\quad 1\ll r<n \\ \text{where } r_0=(\lambda-1-\ln\lambda)^{-1} \tag{3}$$

In approximation (3.2), the term r-1.5 dominates for r ≤ r0 and the exponential term e-r/r0 dominates for r0 ≤ r < n. Thus (3.2), reveals that the distribution of the number of failures has an approximate power law region of exponent -1.5 for 1 < r ≤ r0 and an exponential tail for r0 ≤ r < n.

IV.RESULTS

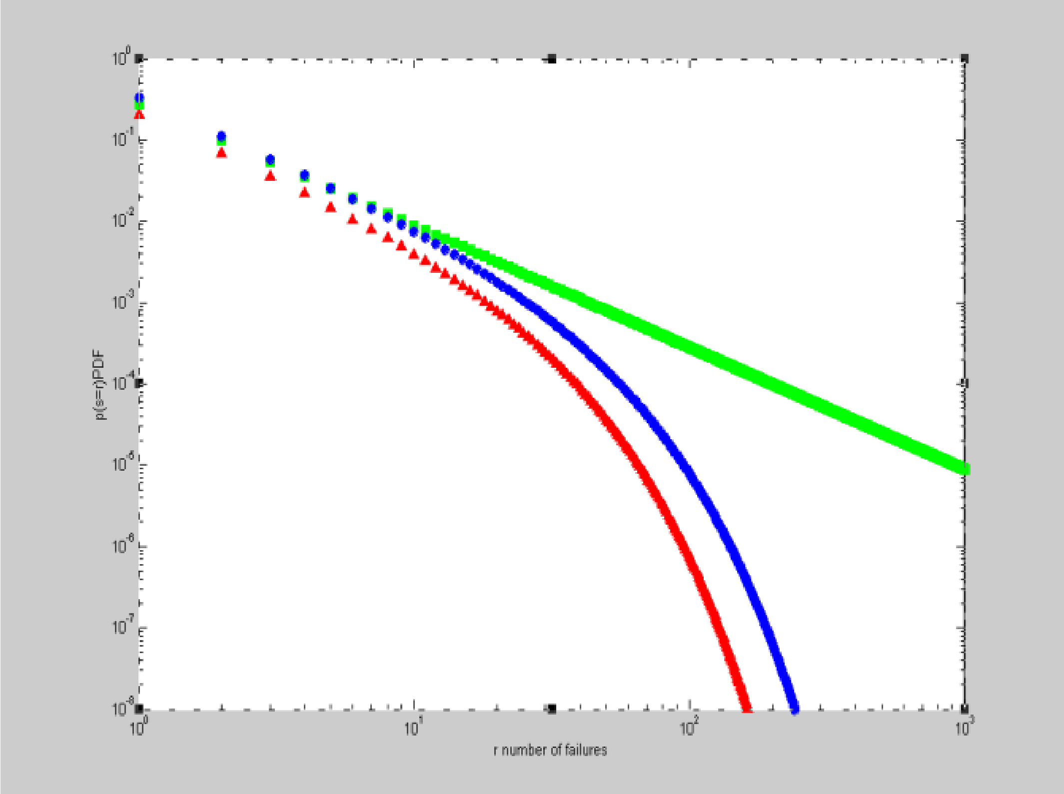

Figure 1: Total Number of Failures in Branching Process Model for Three Values of λ. λ = 0.7 Indicated by Circle, λ = 1.0 Indicated by Square (Critically) and λ = 1.3 Indicated by Triangle

By varying the number of failures (r), the corresponding values of p.d.f. are obtained, and plotted as log-log plot, Figure 1. The qualitative behavior of the distribution of blackout size as λ is increased can now be described. This behavior is illustrated in Figure. 1. For subcritical λ well below 1, r0 is well below n and the exponential tail for r0 ≤ r < n implies that the probability of large blackouts of size near n is exponentially small. The probability of large blackouts of size exactly n is also very small. As λ increases in the subcritical range λ<1, the mechanism by which it develops a significant probability of large blackouts of size near n is that, r0 increases with λ so that the power law region extends to the large blackouts. For near critical λ≈1, r0 becomes large and exceeds n so that power law region extends up to r = n. For supercritical λ well above 1, r0 is again well below n and there is an exponential tail for r0 ≤ r < n. This again implies that the probability of large blackouts of size near n is exponentially small. However there is a significant probability of large blackouts of size exactly n and this probability of total blackout increases with λ.

By varying the number of failures (r), the corresponding values of the blackoutrisk is computed and plotted as log-log plot. Figure. 2 shows thedistribution of risk with respect to the number of failures for the same values of λconsidered in Figure. 1, the essential point is that, given an assumption about theblackout cost, as a function of blackout size, the branching process model gives away to compute blackout risk in terms of λ, i.e., the nature of the blackout riskwhich is proportional to the probability distribution function, will exhibit thesame variation with respect to the number of failures.

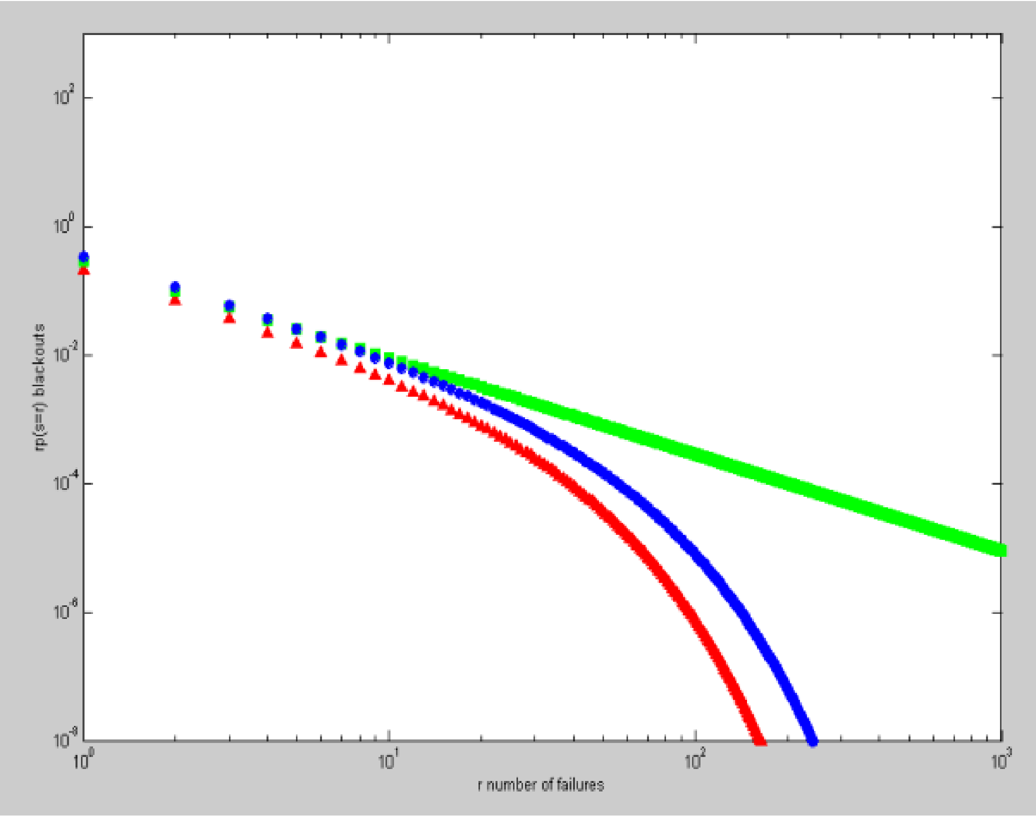

Figure 2: Blackout Risk rp(s=r) and Number of Failures in Branching Process Model for Three Values of λ. λ = 0.7 Indicated by Circle, λ = 1.0 Indicated by Square (Critically) and λ = 1.3 Indicated by Triangle

V. CONCLUSION

The power impact is sharedby the various synchronous machines according to the steady-state characteristicswhich are determined by the steady-state droop characteristics of the variousgenerators. During the transient period, the power impact is shared by the machinesaccording to different criteria. If these criteria differ among the group of machines,each impact is followed by oscillatory power swings among the groups of machinesto reflect the transition from initial sharing of the impact, to reflect the finaladjustment, reached at steady-state. During the system operation, the impact ofsudden addition or removal of loads will be followed by the power swings amonggroup of machines.

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