RELIABILITY AVAILABILITY FAILURE RATE OF VARIOUS GIRD CONNECTED PV SYTEM RENEWABLE ENERGY RESOURCES

DR. K. UMA MAHESWARI¹, K. SUBRAHMANYAM² & DR. R. VIJAYA LAKSHMI³

¹Associate professor, Dept of Humanities and Sciences ,

²Dept of Mechanical Engineering,

³Associate professor, Dept of Humanities and Sciences

¹Srinivasa Ramanujan Institute of Technology,

²JNTUA College of Engineering,

³Srinivasa Ramanujan Institute of Technology, Anantapur, Andhra Pradesh India

ABSTRACT

Recently renewable resources are like solar energy; wind energy generation take place all over world. The reliability, availability of the system having some complex failure rate and repair rate in the electric generation or power generation, based on PV system is pass the signal to transformer line and it is connected to grid via to household can be calculated. The System effects, modelling type among component resistances, coefficients of variations of load and resistances The focus of these papers is primarily on how the collective structure of the specific pieces impacts the subsequent reliability., series, parallel, combination of both arrangements, complex system, failure rate, repair rate, The mean time to failure, the mean time between failures, and the mean time recovery rate. The possibility of increasing reliability through redundancy is explained, as is the allocation of reliability to individual elements. Recognize the system arrival of digital technologies and the incorporation of renewable energy into energy systems in future studies. It will also keep operators updated on the status of the system's different nodes.

KEYWORDS: Reliability, Failure rate, Repair rate, Weibull distribution, Rayleigh distributions.

Received: Dec 01, 2020; **Accepted:** Dec 20, 2020; **Published:** Dec 30, 2020; **Paper Id.:** IJMPERDDEC202093

1. INTRODUCTION

Power system reliability, in general, addresses issues such as Service disruption and power outage It is delineated across several cases as an objective to try in terms of indices directly customer related. Studying the dependability of machine repair problems is critical in our lives because they are widely used in industrial and manufacturing systems. Any system can become unreliable for a variety of reasons. In traditional systems, the system's units have only two states: up and down. Many mathematical concepts, particularly those from probability and statistics, apply to reliability engineering. Many arithmetical distributions, including the Gauss (regular) distribution, the file distribution, the Rayleigh distribution, the exponential function, the Probability distributions, and a slew of others, can be used for a range of functions. Many objects are made up of multiple parts or elements. An element is any component or object that is considered in the investigated case as a whole and is not decomposed into simpler objects from the standpoint of reliability. We evolve analytical expression for the accessibility function, reliability function, and mean probability of failure using Differential equations techniques, and afterwards we execute a parametric inquiry that presents results obtained to examine the effects of various system parameters on system

reliability requirements.

2. METHODOLOGY

2.1 Reliability

Reliability refers to the likelihood that a system will execute properly over a set timeframe. There is no requirement for, or productivity of, repair.

- The system adheres to the performance specifications as specified.
- Reliability implements a logarithmic failure law, that also means it decreases as the period considered for reliability calculations grows longer. In other phrases, the reliability of a system will be large at first, then gradually decline to its lowest severity over time. Reliability $(R(t)) = \frac{-\lambda t}{e}$

2.2 Availability

The possibility that a framework will perform correctly at a given point in time is alluded to as accessibility (not duration). Distractions can occur earlier or after the time case used to calculate the availability of the system.

- Be functional.
- At a time of use, it must meet the defined specifications.
- The steady-state availability is measured, considering potential downtime incidents.

$$\text{Availability } A(t) = \frac{MTBT}{MTBF + MTTR}$$

2.3 Failure Rate

The number of times a component fails in one unit of time. calculate the measurements listed further down in this post. Failure pattern is determined in reliability geotechnical design as predicted failure frequency assuming the element is fully operational in its original conditions.

$$\text{Formula: } (\lambda) = \frac{1}{MTBF} = \frac{1}{MTTF}$$

2.4. Repair Rate

Each number of successful restoration operations on a failed system performed from each unit of time, calculate the measurements listed further down in this post.

$$\mu = \frac{1}{MTTR}$$

2.5 Mean Time to Failure:

The typical time required for a semi system component to are unable.

$$MTTF = \frac{\text{total hrs of operation}}{\text{total no of units}} = 1/\lambda$$

2.6 Mean Time between Failure

The average time among due to shortage of a replaceable system component.

$$M T B F = \text{Total hrs. of operation} / \text{Total no of failures} = 1/\lambda$$

2.7 Mean Time Recovery

The actual duration required to repair a defective part and bring it back into service. This ratio determines the time spent as during alert and diagnosis and treatment processes prior to the start of person who utilizes.

$$MTTR = \text{Total hrs. of maintenance} / \text{Total no of repairs} = 1/\mu$$

2.8 Mean Time Detection

The avg measure of years that elapsed here between incidence and detection of a malfunctions.

$$MTTD = \text{Total hrs. of incidents Detection} / \text{Total no of Incidents}$$

Figure 1: Series and Parallel Connections of Transformer Line to the grid.

Figure 2: Circuit Connection from Grid to Household

The above transformers connections which having series, parallel and mixed connections which having various loads up and down as per time concern and season, based on that the grid has several failure rate and recovery rate as per availability of current supply to the households.

3. VARIOUS COMPONENT SYSTEMS

3.1. Series Component System

The above series component system made up of 'n' component system. It consists of following factors.

- (1) The efficient mission of a series system is composed of the system performing its primary goal.
- (2) For the scheme to be unable, only one element must fail. Let S_i become the event in which the component efficiently performs its primary goal. $i = 1, 2, 3, \dots, n$

If S denotes the series system's reliability, then from the interpretations of reliability as well as system $S = P(E_1 \cap E_2 \cap E_3 \dots \cap E_n)$.

Even though reliability is a probability system, it represents the intersection of events. It is made up of the following elements.

- 1) The efficient mission of a series system composed of the system performing its intended purpose.
- 2) For the system to fail, only one element must fail.

Let S_i indicate the event in which the component efficiently performs its intended function. i , where $i = 1, 2, 3, \dots, n$

If ' S ' denotes the series system's reliability, and from the meanings of validity and series system. $S = P(E_1 \cap E_2 \cap E_3 \dots \cap E_n)$

Because dependability is a possibility, it represents the interconnection of events. If the occurrences E_i ($i = 1, 2, \dots, n$) are not self-reliant, we apply probability distribution and get $P(E_1) P(E_2/E_1) P(E_3/E_1E_2) \dots P(E_n/E_1E_2 \dots E_{n-1})$ $S = P(E_1) P(E_2/E_1) P(E_3/E_1E_2) \dots P(E_n/E_1E_2 \dots E_{n-1})$ Where $E_1E_2 = E_1 \cap E_2$, $E_1E_2E_3 = E_1 \cap E_2 \cap E_3$, and so on.

E_i ($i = 1, 2, \dots, n$) are self-contained, as is the n we are interested in.

$$R = P(E_1)P(E_2)P(E_3) \dots P(E_n) \quad \left(\because P\left[\frac{E_i}{E_j}\right] = P[E_i] \text{ if events } E_i \text{ \& } E_j \text{ are independent, etc} \right)$$

(or)

$$R = \prod_{i=1}^n R_i, \text{ for a mission of operation per unit time.}$$

Where $R_i = P(E_i)$

Reliability of the series system, the mission of 600 hrs, where the given reliabilities of the components are for 600 hrs,

Single component

$$R = R_1 \times R_2 \times R_3 \times R_4 \dots R_n \text{ for mission 600 hrs} = 0.80 \times 0.98 \times 0.65 \times 0.50 \Rightarrow 0.2548$$

Table 3.1.: Three Component System for Series

S. No	Reliability of the First Component 0.8	Second Component 0.98	third Component 0.65	Reliability of given Components Systems	Per of the total System
1	0.8	0.98	0.65	0.224	25
2	0.7	0.68	0.55	0.280	14
3	0.4	0.80	0.9	0.256	12
4	0.6	0.70	0.8	0.252	11

Series Mean time failure rate (MTTF): $MTTF = \int_0^{\infty} R(t) dt$

$$MTTF = 1/\lambda$$

Figure 3.2.1: Mean Time Failure Rate of Reliability

3.2. Reliability of a Parallel System

The parallel system consists of

1. One element must function properly for the provided system to operate, and all other components must fail.

2. Let $(-1) E_1$ be the incident in which the element effectively needs to perform its intended of feature to the event Eid. Let $(-1) S I$ be the component of reliability I where $I = 1, 2, 3 \dots n$ for a mission of $(-1)t$ time units. As a result, parallel parallel system is $R = P(E_1 \cup E_2 \cup E_3 \cup \dots \cup E_n)$

$$P(A) + P(\bar{A}) = 1, \text{ there } A = E_1 \cup E_2 \cup E_3 \cup \dots \cup E_n$$

$$R = 1 - P(\bar{E}_1 \cup \bar{E}_2 \cup \bar{E}_3 \cup \dots \cup \bar{E}_n)$$

By using De-Morgan's law, we get at last

$$R = I - (I-R_1) (I-R_2) (I-R_3) \dots (I-R_n)$$

$$R = I - \frac{n}{I-I} (I-R_i) \text{ for } \frac{-1}{n} \text{ mission}$$

$$R = I - (I-R_1) (I-R_2) (I-R_3) \dots (I-R_n)$$

$$R = I - (1-0.60) (I-0.75) (I-0.95) (I-0.80)$$

$$= 0.999 \text{---for mission of 90 day}$$

3. Reliability of Both Series and Parallel System

Where $R_1 = 0.80$, $R_2 = 0.75$, $R_3 = 0.50$, $R_4 = 0.65$, $R_5 = 0.76$, $R_6 = 0.60$, $R_7 = 0.95$, $R_8 = 0.90$.

Where $R_1 = 0.80$, $R_2 = 0.75$, $R_3 = 0.50$, $R_4 = 0.65$, $R_5 = 0.76$, $R_6 = 0.60$, $R_7 = 0.95$, $R_8 = 0.90$

$$\begin{aligned} R_9 &= 1 - (1-R_2) (1-R_3) (1-R_4) \\ &= 1 - (I-0.75) (I-0.50) (I-0.65) \\ &= I-0.0438 = 0.9562 \end{aligned}$$

$$R_{10} = I - (I - R_5) (I - R_6)$$

$$= I - (I - 0.76) (I - 0.60) = I - 0.96 = 0.904$$

$$R_{11} = R_1 R_9 R_{10} = 0.80 \times 0.9562 \times 0.904 = 0.6915$$

$$R_{12} = R_7 R_8$$

$$= 0.95 \times 0.90 = 0.855$$

$$R_{13} = I - (I - R_{11}) (I - R_{12}) = I - 0.085 \times 0.145$$

$$= 0.9553$$

∴ Mixed system of reliability is 0.9553'

3.4 Mean Time Failure Rate of Parallel System

Figure 3.4.3.: MTTF of Parallel System

3.5 Reliability (Analytical) Time – Dependent System

Life Predictions Based on Analytical Data

Rupees = $R_1.R_2.R_3$ for system reliability

The valves R_1 , R_2 , R_3 were provided for a common time and the structural integrity was estimated for both the time, as system reliability is time – dependent.

$R_s(t) = R_1(t) R_2(t) R_3(t)$ According to Weibull life distribution of each component, the eq^h is $R_s(t) = e^{-(t/n^{t_n})^{B_1}}$
 $e^{-(t/n^2)^{B_2}} e^{-(t/n^3)^{B_3}}$

$$R_s(t) = e^{-(t/n^1)^{B_1}} e^{-1/2t} \left(I - \phi \left(\frac{t-43}{03} \right) \right)$$

Assume that component as follows exponential distribution with mean of 10,000 $\left(\pi = 10,000, \lambda = \frac{1}{10,000} \right)$ & component 2 follows a Weibull distribution with $P = 6$, $n = 10,000$ The reliability equation

$$R_s(t) = R_1(t) R_2(t) = e^{-\frac{1}{10,000}t} e^{-\left(\frac{t}{10,000}\right)^6}$$

$$\text{System } F_5(t) = 1 - (R_1(t) R_2(t))$$

$$= 1 - \left(e^{-\lambda t} e^{-(t/n)^B} \right) = F_5(t) = \frac{-d(R(t))}{dt}$$

Figure 3: Failure Rate of System

3.6. Conditional Reliability Failure System

$$R(+/7) = \frac{R(T+t)}{R(T)} \quad t = 1000 \text{ hr, } T = 500 \text{ hrs.} = 0.9048$$

System failure

$$\lambda_5(t) = \frac{f_5(t)}{R_5(t)}$$

For two component system

$$\lambda_5(t) = \frac{\frac{-d}{dt} \left(e^{-\frac{1}{10,000}t} e^{-\left(\frac{t}{10,000}\right)^6} \right)}{e^{-\frac{1}{10,000}t} e^{-\left(\frac{t}{10,000}\right)^6}} = \frac{f_1}{R_1} + \frac{f_2}{R_2} = \lambda_1 + \lambda_2$$

Figure 4: Failure Rate of complex System

4. CONCLUSIONS

In this paper, a numerical equation of rate of failure, availability, reliability, and mean time rate of failure for a repairable process of different Gird connected PV structure renewable energy was developed, probability density function, complex system, conditional mean failure system were obtained and the results as been shown in graph representation, mostly as of my failure rate less in complex type of PV system.

5. REFERENCES

1. Medhi.J. stochastic processes, New age international limited publishers New Delhi 2006.
2. Agrawal S.C manta s and shikha, IJRRR applied sciences 3(2),2010 1932-1999.
3. Weil, Attahiru,s.a & yigiang, Journal of microelectronics reliability 1998.
4. El-Dames M.A Sharma mis reliability & availability analysis of a repairable system JGokul journal 64(5),2014 7.5-83.
5. Srinath LS reliability Engineering East west press, New Delhi2013.
6. Bal Guruswamy E. reliability Engineering, Tata MacgrawHill, New Delhi.
7. Wai-ki-ching Michael k.ng, Markova chains algorithms applications NewDelhi-2008.
8. Dhillon B.s Reliability Engineering applications areas, Beta publishers, Gloucester ontario1992.
9. Johnson Barry 1988, Design &analysis of fault tolerant digital systems.
10. Reni Nagarajan marline Anita a Chandrababu amurca models in system reliability with applications.