Mansoura Engineering Journal

Volume 2 | Issue 1 Article 1

6-1-1977

Factors Influencing Probability of Forced Outage (Reliability Level) of Transmission Systems.

Mohamed Mohamed Tantawy
Associate Professor., Electrical Power & Machines Department., Faculty of Engineering., El-Mansoura University., Mansoura., Egypt., mtantawi@mans.edu.eg

M. El-Maghraby
Assistant Professor., Electrical Power & Machines Department., Faculty of Engineering., El-Mansoura University., Mansoura., Egypt,

"FACTORS INFLUENCING PROBABILITY OF FORCED OUTAGE (RELIABILITY LEVEL) OF TRANSMISSION SYSTEMS"

BY

M.Abd El-Moneim Tantawy & M.Helmy El-Maghraby*

Part I. Effect of weather conditions.

ABSTRACT:

The goal of this research is to assign the season during which the opted various systems having best and high reliability level along six years of research. This aim is satisfied by suggesting a new classification for the reliability level by the aid of which we determine not only the conditions for having best reliability level but also a complete classification is attained and their corresponding seasons. This is executed for each interconnector along the years of research. Numerous statistical data is collected including the instances of disconnection and connection for each outage along each year of the research period. The systems opted for research are parts of the ARE unified power system.

1- INTRODUCTION:

The term reliability, availability, adequacy, dependability and security are defined as the needs for capability by certain specific system. The application of these terms has evolved over many decades, and therefore usage of some of the terms is unique to the area of power system applications.

---

* Lecturers - Faculty of Engineering - Mansoura University.

Mansoura Bulletin June 1977.

As a goal, the evaluation and computation of electric power ystem reliability requires a consistent technique to be used for ll portions - generation, transmission and distribution system[3]. t present, a number of different methods are used for the genertion systems, while the frequency and duration of outage seem to e developed as a standard measure for the analysis of the distrbution system. A reliability calculation method for the generaion system incorporates the frequency and the duration of unit utages including load curves consideration. This method leads o calculating the transmission reliability measures which are: vailability, frequency of occurrence, and mean duration of eserve states. These are cumulative states in which they specify ne system reserve conditions of a given magnitude[3]. Analysis of ower system reliability is a problem area which has received onsiderable attention along the years. Most of these efforts as been expended in the reliability analysis and reserve requrement planning of transmission system. A renewed interest in his particular problem naturally arises when efforts are made o integrate this work with more recent efforts that have been enoted to the evaluation of the reliability of the transmission nd distribution systems. Immediately one is confronted with the vergence of reliability measures commonly used in the various ortions of the system and with their apparent lack of compatibity[3]. The function of modern power systems is to satisfy the ystem load as economically as possible, and with a reasonable vel of continuity and quality[4]. This latter aspect has been, nd always will be, of considerable concern to power - system ngineers and managers. Power systems contain, by design, many dundant elements strictly for the purpose of increasing the surance of continuity and the provision of high-quality serce to the customers. Redundancy is provided in many forms such generation - capacity reserve margines, interconnections with ighbouring utilities, additional transmission and distribution ements and the simple or complex alternate supply facilities ich exist in virtually all functional areas in some form or another. These facilities exist because the basic system design philosophy recognises, and therefore anticipates the possibility of equipment failure and the need to remove equipment from service to perform preventive maintenance[4].

2. INFLUENCE OF WEATHER CONDITIONS:

2.1 The System Load:

The effect of weather on system load depends primarily upon the load and weather characteristics of the system under consideration. For example, a system having a high percentage of certain types of industrial load which may not be heat sensitive, may be affected very little by weather if the air conditioning saturation is quite low. Some weather load models may be developed for a given system having specific characteristics and are, therefore, not be applicable to another system having different characteristics. It would appear that this weather load model should be applicable to systems having a wide range of different loads and weather characteristics. The general effect of weather on system load both demand and energy can easily be determined from a few years of historical information. One should obtain as much historical information concerning the load characteristics as practical before attempting a weather load correlation analysis.

2.2 The Reliability level:

2.2.1 Network elected for study:

A certain transmission system is studied to get the probability of forced outage in addition to the reliability of this system. The system is opted a part of the A.R.E unified power system. The system under survey consists of three interconnectors which are defined as:

L_1 : (Talkha - Tanta) interconnector,

L_2 : (Talkha - El-Zagazig) interconnector,

and L_3 : (Tanta - Damanhour) interconnector.

for the 66 and 220 KV systems.

2.2.2 Numerical application:

It is required to derive the influence of the weather conditions on the probability of the forced outage, that is, the reliability of this system of each transmission line during the various seasons of the research years (winter, spring, summer, and autumn). Winter season has a period beginning at 21th of December, till 20th of March of consequative year or 2160 hours, when February having 29 days, and 2136 hours for February having 28 days. Spring season has a period initiated by 21 March and terminated by 20 June which includes 2184 days.

Summer season has a period initiated by 21 June and finished by 20 september which includes 2184 hours.

Eventually autumn season has a period initiated by 21 September and finished by 20 December.

2.2.3 Graphical representation of probability of forced outage:

The seasons have high effect on the probability of forced outage through a certain specified period, which yields to a proper prediction for the reliability in the future.

Temperature and wind variations have an influence on the fault occurring. The probability of forced outage depends on the outage time. It is noticed that for a higher value of the outage time the transmission system has a bad reliability where for the lower value of the outage time a good reliability may be obtained.

This research is expressed in a graphical form shown in Figs. (1), (2),....(6) for the two systems 66 and 220 KV over six years of research period (72 months).

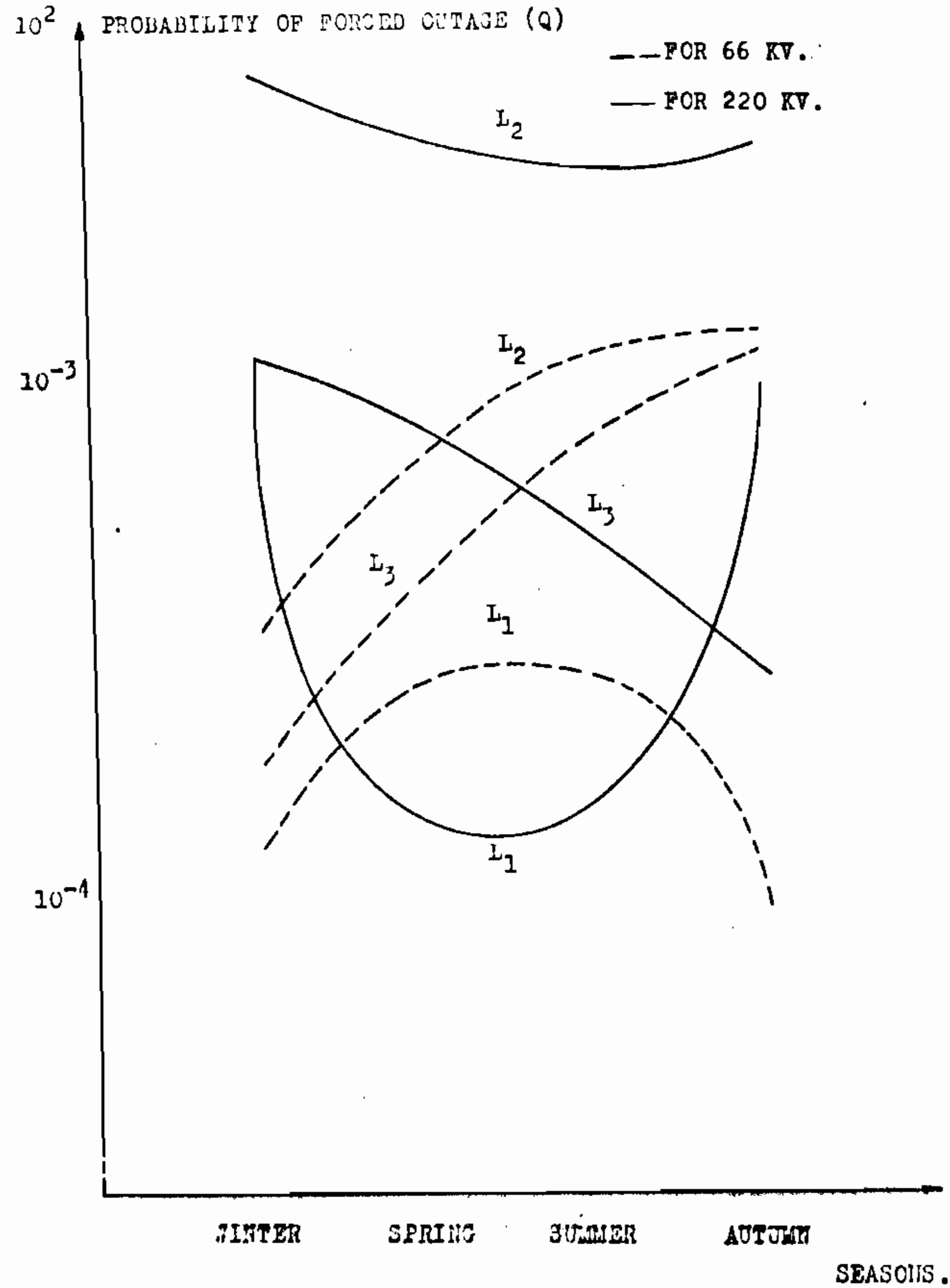

Fig. (1) PROBABILITY OF FORCED OUTAGE SEASONS CHARACTERISTICS, FOR THE OPTED NETWORK DURING 1971 YEAR.

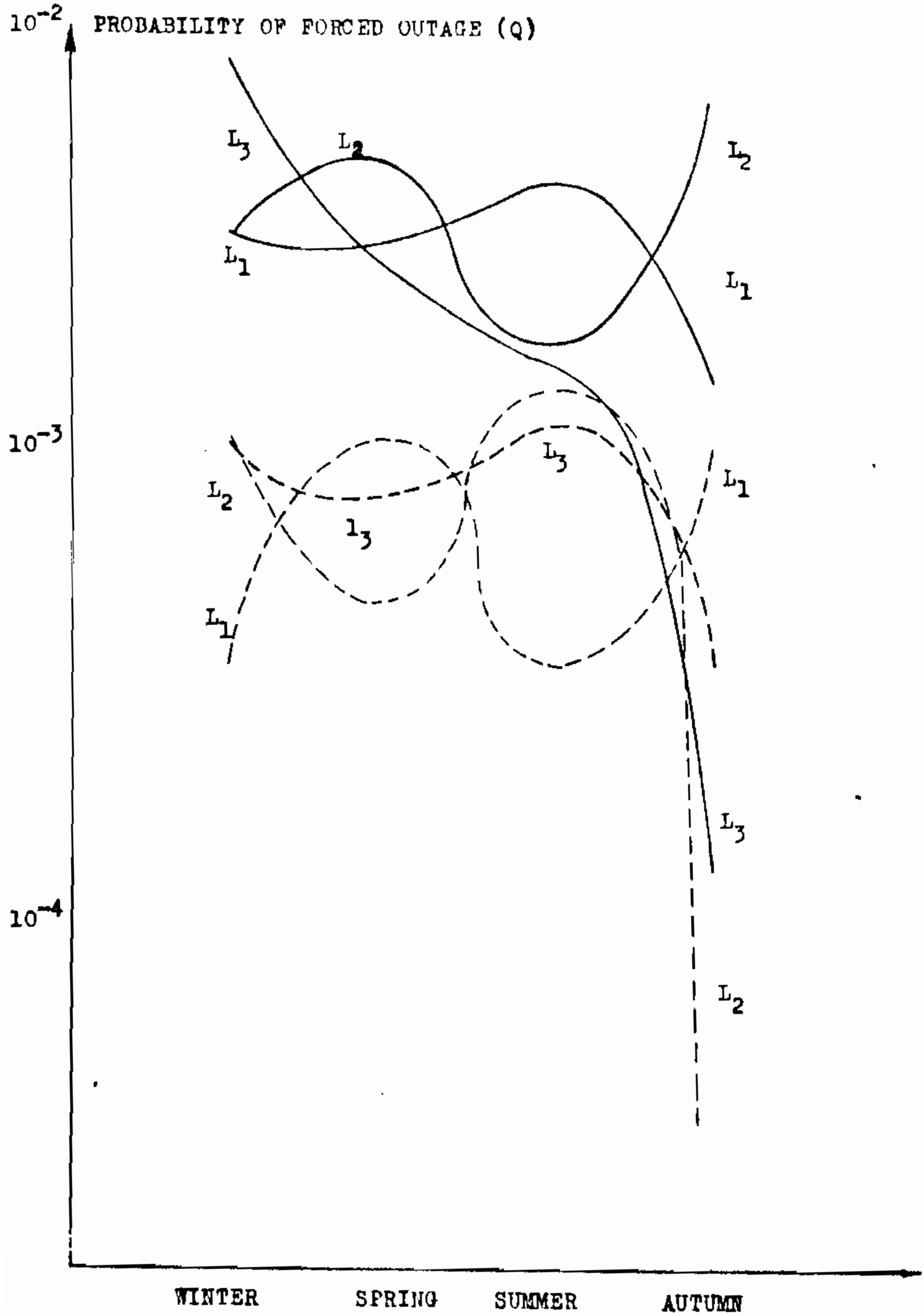

Fig. (2) Probability of forced outage seasons characteristics, for the opted network during 1972 year.

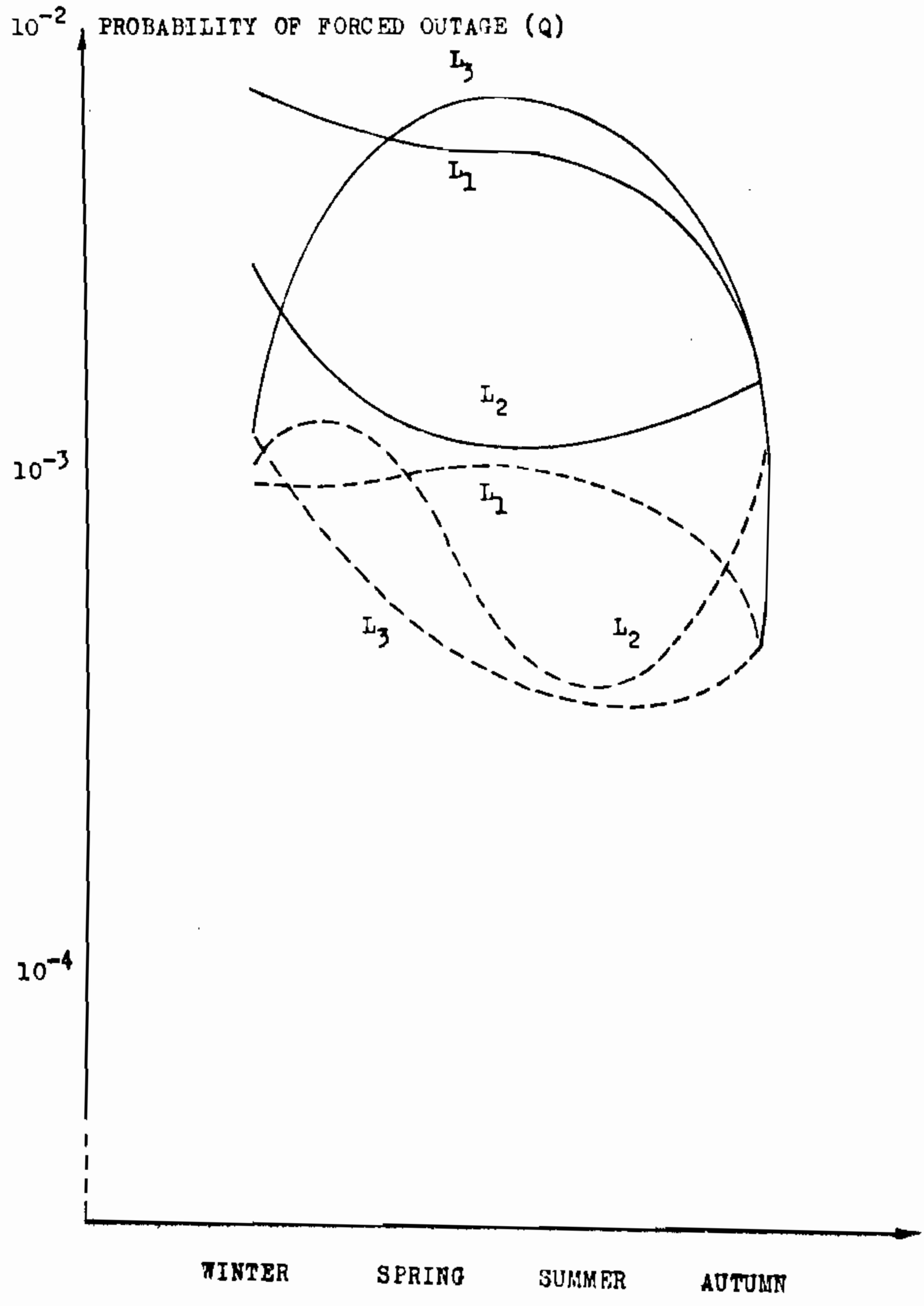

Fig. (3) Probability of forced outage seasons characteristics, for the opted network during 1973 year.

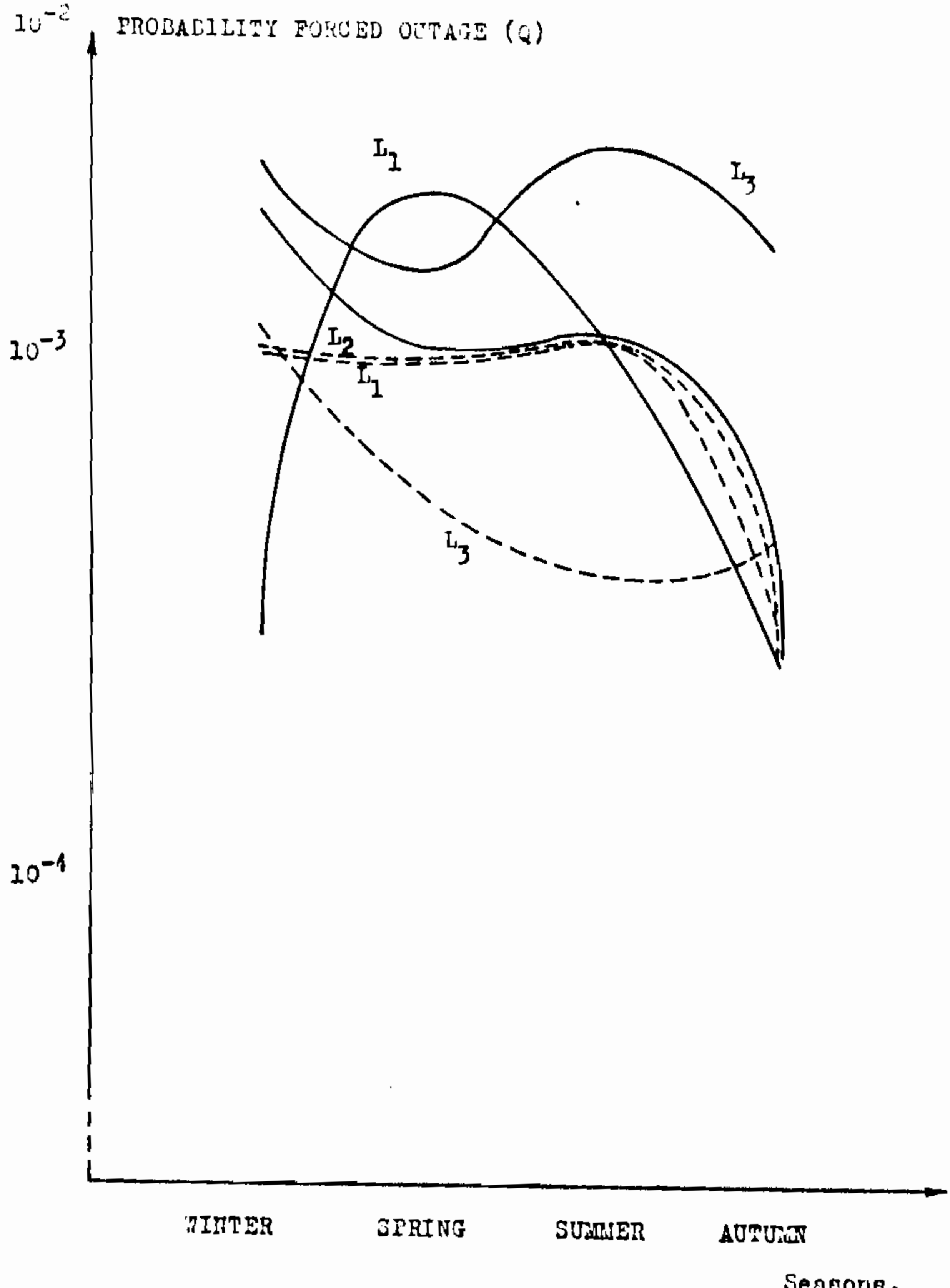

Fig. (4) Probability of forced outage seasons characteristics, for the opted network during <u>1974</u> year.

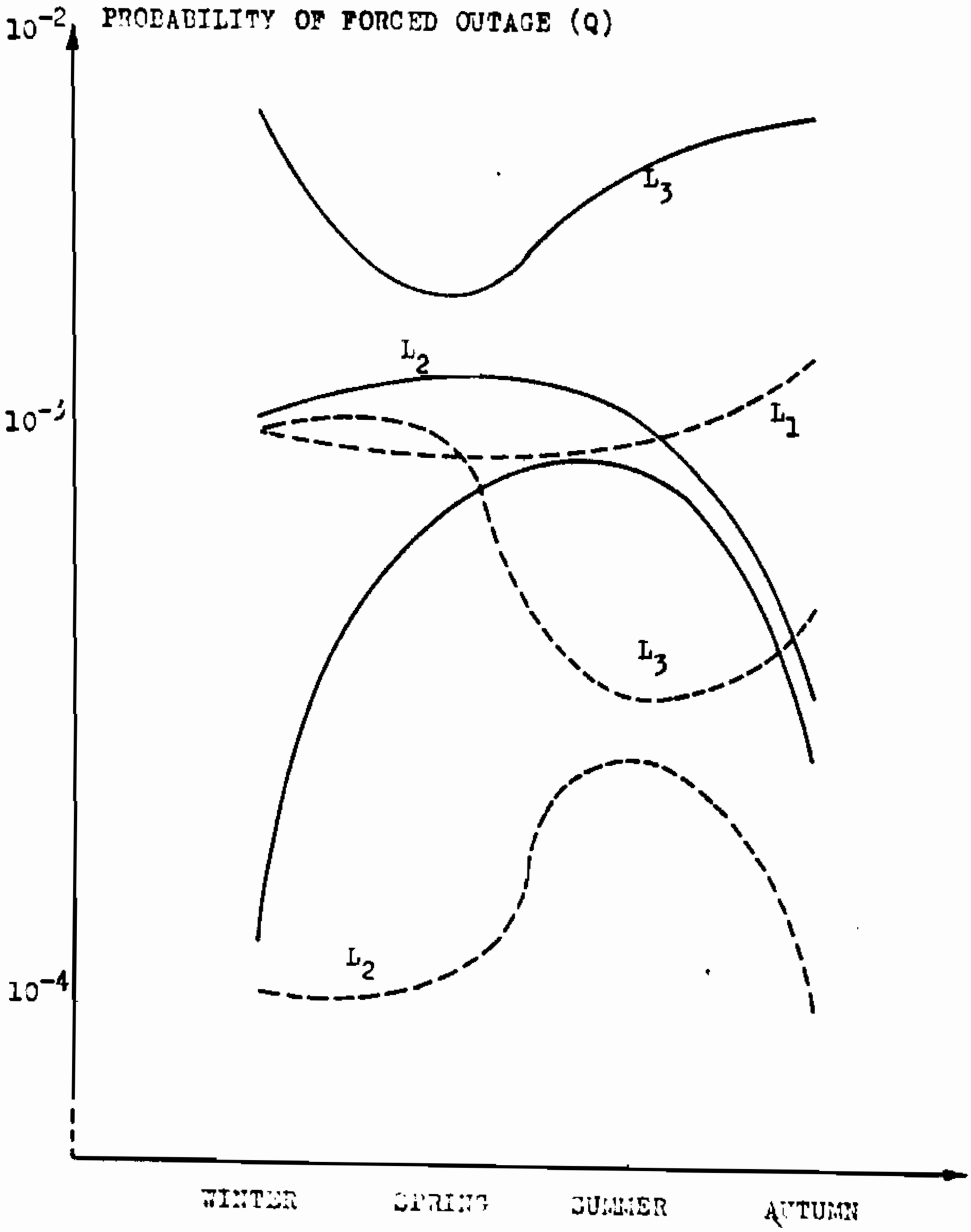

Fig. (5) Probability of forced outage seasons characteristics, for the opted network during 1975 year.

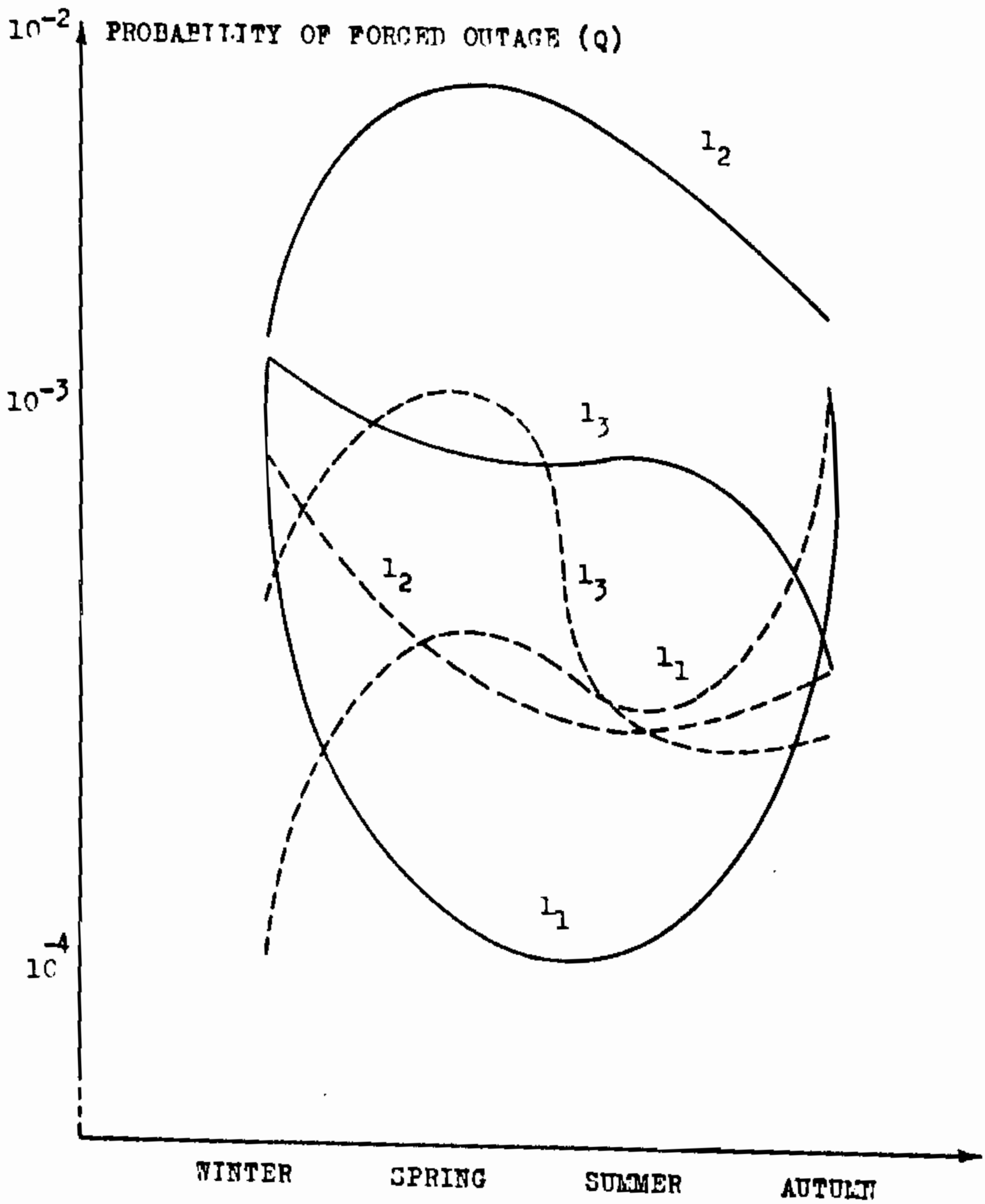

Fig. (6) Probability of forced outage seasons characteristics, for the opted network during 1976 year.

Tables (1) and (2) summarize the characteristics and records of the probability of forced outage for 66 and 220 KV interconnector systems respectively over each year of the research period. These tables also illustrate the class of the probability of forced outage at the various weather conditions i.e. different seasons. Class A indicates lower probability of forced outage i.e. higher and best reliability level of the transmission system.

Class B is the next one to class A, however, class C displays the third category with respect to the better reliability level.

Class D expresses the bad reliability level. Referring to Table (1) of 66 KV system, the summer season has a comparitively good reliability through the six years of research. This ascribed by the fact that this season has the best and highers reliability level (class A) during major part of the years, 1973,1975 & 1976. However the autumn season has the next number of repetitions of class A to the summer season through 1972 and 1974.

Finally the winter season is the third one other the preceding two seasons which have class A since it has the property of this class during the year of 1971 only.

On the other hand the winter season has a bad condition of reliability (class D) along the period of study (six years) since the properties of this class occur during the years: 1973, 1975 and 1976.

Regarding to Table (2) for 220 KV system we can conclude that the autumn is the season which has the best and higher level of reliability (class A) through a comparatively main part of the period of research (1972, 1973 and 1975). Spring season is the second category next to the autumn one since it has class A during the years 1971 and 1974 only.

Table (1): Probability of forced outage for 66 KV. system.

Year	Lines / seasons	L_1	L_2	L_3	Class.
1971	Winter	1.9×10^{-4}	5.8×10^{-4}	2.6×10^{-4}	A
	Spring	5.1×10^{-4}	10×10^{-4}	16×10^{-4}	C
	Summer	5×10^{-4}	10×10^{-4}	6×10^{-4}	B
	Autumn	1×10^{-4}	15×10^{-4}	17×10^{-4}	D
1972	Winter	6×10^{-4}	15×10^{-4}	10×10^{-4}	C
	Spring	11×10^{-4}	7×10^{-4}	9×10^{-4}	B
	Summer	6×10^{-4}	19.7×10^{-4}	15×10^{-4}	D
	Autumn	10×10^{-4}	0.6×10^{-4}	6×10^{-4}	A
1973	Winter	9.8×10^{-4}	11.1×10^{-4}	20×10^{-4}	D
	Spring	10×10^{-4}	11×10^{-4}	7×10^{-4}	C
	Summer	10×10^{-4}	6.3×10^{-4}	6×10^{-4}	A
	Autumn	7×10^{-4}	11×10^{-4}	7×10^{-4}	B
1974	Winter	11.2×10^{-4}	12×10^{-4}	16×10^{-4}	C
	Spring	10×10^{-4}	10×10^{-4}	7×10^{-4}	B
	Summer	14×10^{-4}	15×10^{-4}	6.2×10^{-4}	D
	Autumn	5.6×10^{-4}	5×10^{-4}	7×10^{-4}	A
1975	Winter	11×10^{-4}	1.2×10^{-4}	11×10^{-4}	D
	Spring	10×10^{-4}	1.5×10^{-4}	10×10^{-4}	C
	Summer	10×10^{-4}	5×10^{-4}	6×10^{-4}	A
	Autumn	24×10^{-4}	1.1×10^{-4}	7.4×10^{-4}	B
1976	Winter	1.4×110^{-4}	9.4×10^{-4}	7×10^{-4}	D
	Spring	6.6×10^{-4}	6×10^{-4}	14×10^{-4}	B
	Summer	5.5×10^{-4}	6×10^{-4}	5×10^{-4}	A
	Autumn	16×10^{-4}	6×10^{-4}	5.1×10^{-4}	C

Table (2) : Probability of forced outage for 220 KV system.

Year	Lines / Seasons	L_1	L_2	L_3	Class
1971	Winter	12×10^{-4}	65×10^{-4}	16×10^{-4}	D
	Spring	2.1×10^{-4}	34×10^{-4}	24×10^{-4}	A
	Summer	2×10^{-4}	66×10^{-4}	5×10^{-4}	C
	Autumn	11×10^{-4}	52×10^{-4}	5×10^{-4}	B
1972	Winter	48×10^{-4}	48×10^{-4}	81×10^{-4}	D
	Spring	47×10^{-4}	61×10^{-4}	42×10^{-4}	C
	Summer	58×10^{-4}	28×10^{-4}	25×10^{-4}	B
	Autumn	23×10^{-4}	72×10^{-4}	2.3×10^{-4}	A
1973	Winter	76×10^{-4}	45×10^{-4}	16×10^{-4}	C
	Spring	66×10^{-4}	14×10^{-4}	21×10^{-4}	B
	Summer	62×10^{-4}	99×10^{-4}	71×10^{-4}	D
	Autumn	25×10^{-4}	26×10^{-4}	7.2×10^{-4}	A
1974	Winter	5.2×10^{-4}	35×10^{-4}	44×10^{-4}	C
	Spring	39×10^{-4}	2.3×10^{-4}	25×10^{-4}	A
	Summer	53×10^{-4}	16×10^{-4}	47×10^{-4}	D
	Autumn	53×10^{-4}	5×10^{-4}	29×10^{-4}	B
1975	Winter	2.1×10^{-4}	14×10^{-4}	62×10^{-4}	C
	Spring	9×10^{-4}	10×10^{-4}	33×10^{-4}	B
	Summer	10.3×10^{-4}	15×10^{-4}	52×10^{-4}	D
	Autumn	5×10^{-4}	6×10^{-4}	61×10^{-4}	A
1976	Winter	16×10^{-4}	21×10^{-4}	19×10^{-4}	D
	Spring	2.1×10^{-4}	61×10^{-4}	9.4×10^{-4}	C
	Summer	1.4×10^{-4}	49×10^{-4}	9.4×10^{-4}	A
	Autumn	10×10^{-4}	25×10^{-4}	5×10^{-4}	B

Eventually, summer season has the best reliability level during 1976 only.

For the 220 KV system, the winter and summer seasons have class D i.e. bad reliability condition during the six years of research.

It is required to study the phenomenon of the variation of the probability of forced outage through the period of research for each individual season.

This study is executed for both our systems. The comparison between the season's variations along the specified periods is very necessary to determine the limitation of the probability of forced outage (reliability level) for each season for the two systems under consideration.

The (probability of forced outage (q)-years of research) characteristics, are given in Figs. (7), (8),...(10). From these characteristics we can note that:

1. The probability of forced outage for the 66 KV system has a lower value at the winter season during the 1971 and 1976 years than the other years. However the variation of the characteristics along the six years of research has the same shape. But for the 220 KV system the probability of forced outage changes such that their characteristics situate in the upper side of that of the 66 KV system in most years of research (Fig. 7).

2. During the spring season (Fig. 8) the probability of forced outage changes from year to another for both two systems, except the first (L_1) transmission line for 66 KV system which has lower values during the 1971 and 1976 years, also the probability of forced outage ratios of the 220 KV system are often higher than the first system.

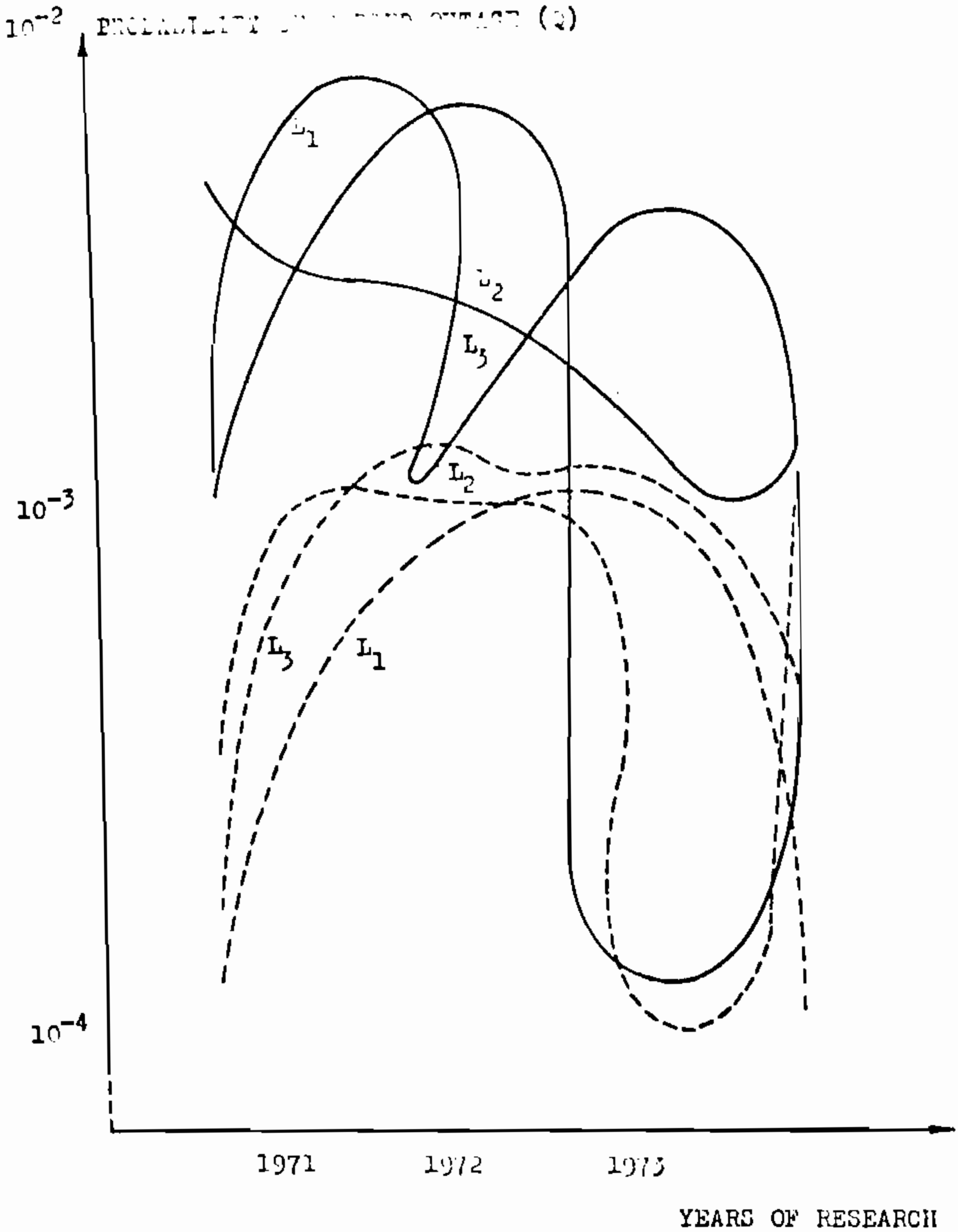

Fig. (7) PROBABILITY OF FORCED OUTAGE YEARS OF RESEARCH CHARACTERISTICS FOR THE OPTED NETWORK DURING THE WINTER SEASON.

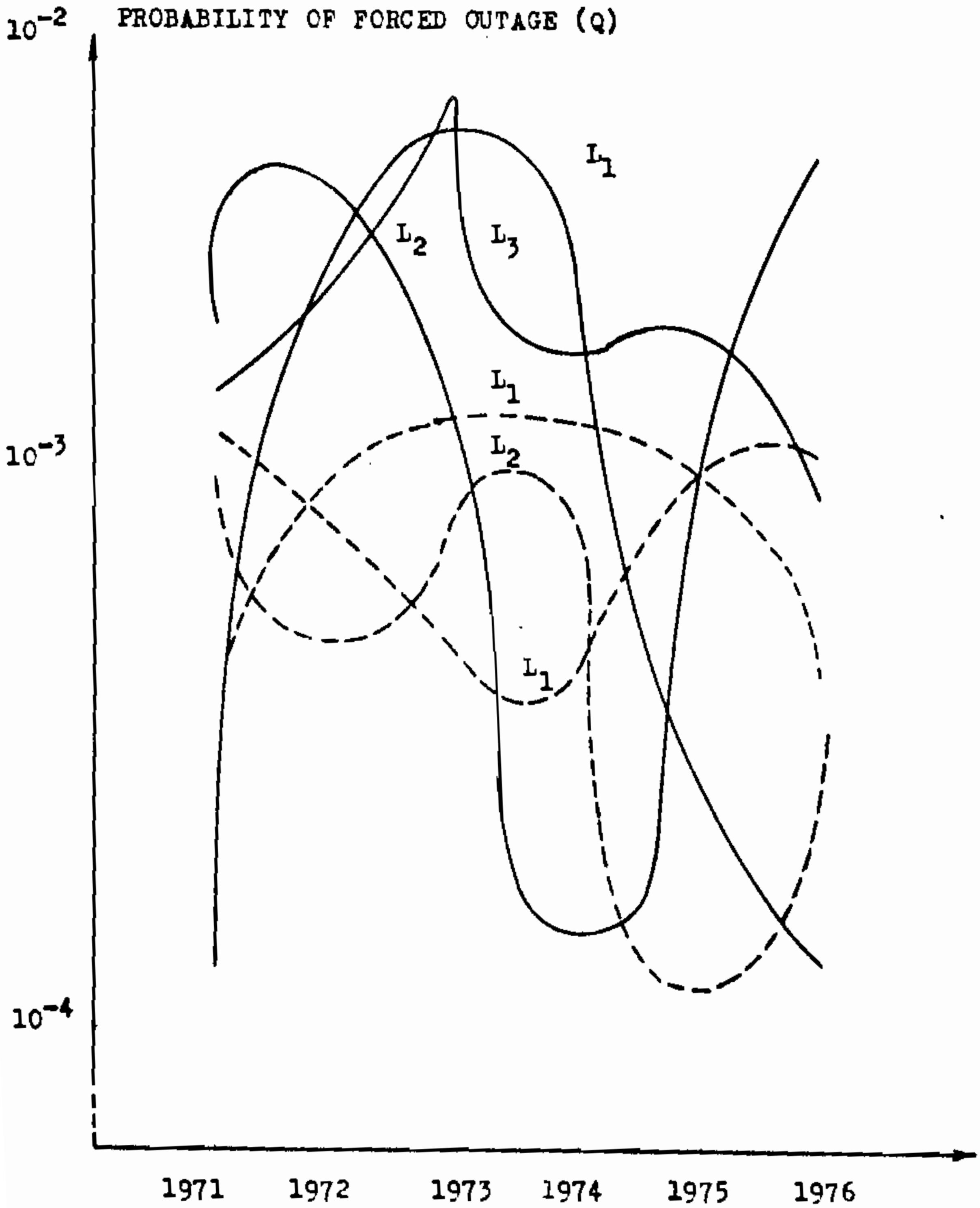

Fig. (8) PROBABILITY OF FORCED OUTAGE YEARS OF RESEARCH CHARACTERISTICS FOR THE OPTED NETWORK DURING THE SPRING SEASON.

3. The probability of forced outage through the summer season differs from point to another along the six years of research except the first (L_1) transmission line for the 220KV system which has lower values during the 1971 and 1976 years.

The probability of forced outage has a higher value at the summer season than the other seasons, i.e. the outage time at the summer season is greater than the outage time of other seasons (Fig. 9).

4. During the autumn season, the probability of forced outage has a variance value from point to another along the years of study and the transmission lines characteristics (Fig.10).

5. The reason of variations of the probability of forced outage from year to another along certain seasons is ascribed by the fact that the repair time is not similar.

It is very important from the point of view of practical consideration for making the repair time to have a minimum value. This lead to better reliability level.

3. CONCLUSIONS:

From the previous research we have the following conclusions.

1. For the 66 KV system the summer season has the best and high reliability level (class A) during all the years of research. However the autumn season is the next one which has less reliability level since it has this characteristic through two years only (1972 and 1974) along the same period of study.

On the other hand the winter season has a bad condition of reliability level (class D) through our period of research.

2. The autumn season has the best and high reliability level (class A) for the 220 KV system during the major part of the

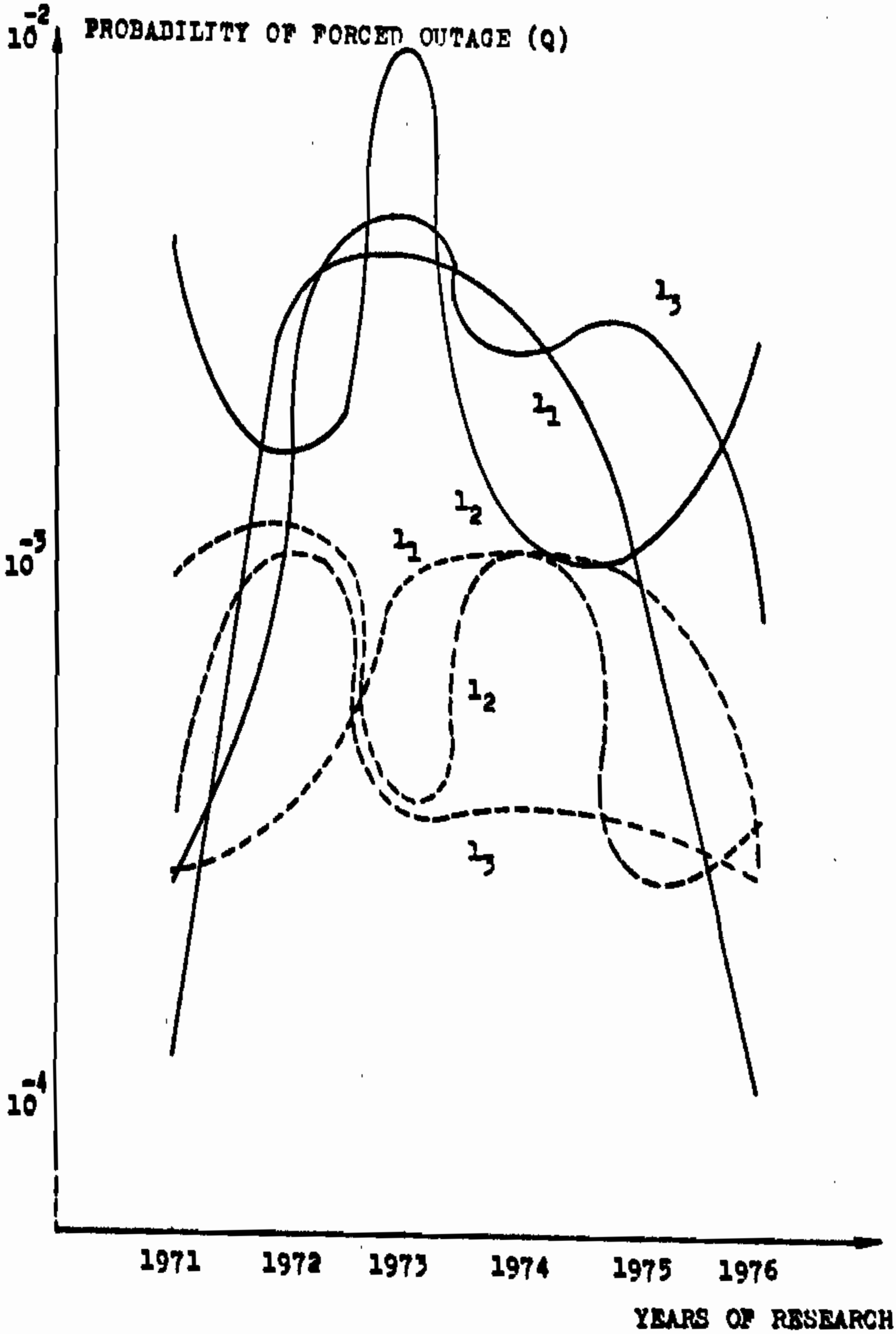

Fig. (9) PROBABILITY OF FORCED OUTAGE YEARS OF RESEARCH CHARACTERISTICS FOR THE OPTED NETWORK DURING THE SUMMER SEASON.

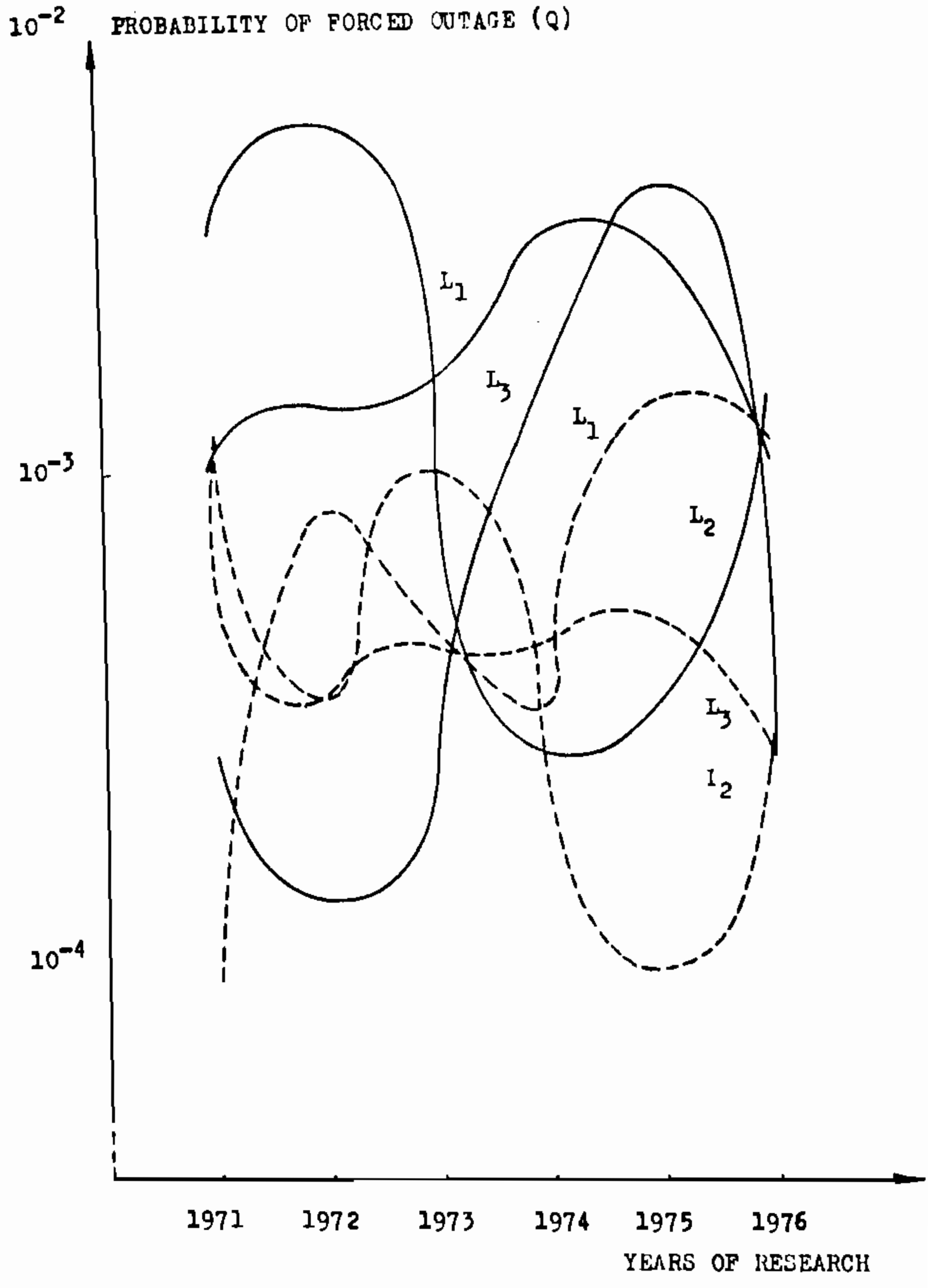

Fig. (10) PROBABILITY OF FORCED OUTAGE YEARS OF RESEARCH CHARACTERISTICS FOR THE OPTED NETWORK DURING THE AUTUMN SEASON.

period of research (1972, 1973 and 1975). Spring season is the second category since it has class A during the years 1971 and 1974 only.

Eventually the summer season has the best reliability level during 1976 year only.

The winter and summer seasons have class D i.e. bad reliability condition during all six years of survey.

3. The probability of forced outage for both systems differs along the six years of study for each season. The repair time must has a minimum value which leads to a better relility level.

BIBLIOGRAPHY:

1. C.C. Asbury, "Weather load model for electric demand and energy forcasting" IEEE, Transactions on power apparatus and systems, Vol. PAS - 94, no. 4, July/August 1975.

2. Eng. Alaa El-Deen Mahmoud Mohamed. "Reliability of transmission systems and factors affecting it" M. Sc. Thesis in Electrical engineering from Faculty of Engineering - Mansoura University. 1977.

3. Power System protection. (Book), Edited by: The electricity Council, Vol. I & II 1969.

4. R. Billinton, "Reliability evaluation in distribution and transmission systems", Proc. IEE, Vol, 112, No. 5, PP. 517 - 523, May 1975.

Part II: Effect of types of fault

ABSTRACT:

The demand is to prove that the single phase-to-ground fault has lower reliability level than for other types of faults for all interconnectors of various systems. To satisfy this requirement, statistical data during six years is gathered for the outages and their corresponding types of fault for each transmission line, thus, reliability level is computed under the constraints considered. Also, it is required to determine the effect of other types of fault under the same conditions. Series of curves are plotted to explain these requirements.

1. INTRODUCTION:

The main factors affecting transmission systems reliability are:

a) Transmission and substation planning.
b) Overloading, and
c) Faults on transmission networks.

We shall concern here with the third factor. Most of the faults that occur on power systems such as short circuits faults impedances, or open conductors are unsymmetrical faults. They are classified to single line-to-ground, line-to-line or double line-to-ground faults. The path of the fault current from the line-to-line or line-to-ground may or may not contain one impedance. One or two open conductors result in symmetrical faults, either through the breaking of one or two conductors or through the action of fuses and other devices that may not open the three phases simultaneously.

With respect to the shunt faults, the analysis of unbalanced fault conditions involves-in general, the three-phase sequence networks of the given power system namely the positive, negative, and zero sequence networks. It is convenient to represent each sequence network in its simplest form as viewed the point of short-circuit fault. The calculations of shunt faults involve:

a) Three phase symmetrical short circuit,
b) Phase-to-phase fault,
c) Single phase-to-earth fault,
d) Two phase-to-earth fault,
e) Effect of fault impedance.

Open-circuit conditions, normally, of interest in the power -system analysis are:

The single - phase open - circuit and the two-phase open-circuit.

The remaining possiblity, namely the three phase open-circuit, is of little practical significance. Analysis of these conditions is achieved by the use of the symmetrical components, that is by considering voltage and current constraints produced by the fault condition at the point of fault.

For shunt faults analysis, single-phase-to-earth fault is restrictive occurring on transmission system, then double phase-to-earth fault. In these cases, zero sequence impedance insertion in the current fault calculations, gives higher effect. These types of faults need higher outage time. The arc impedance has double effect as the path impedance ($Z_{arc} = 2\ Z_p$) for cases phase-to-phase and double phase-to-earth faults.

For series faults, single-phase open-circuit fault calculation, is the same as double-phase-to-ground fault, and double-phase open-circuit fault calculation is typical for single-phase-to-earth fault.

The analysis of simultaneous faults condition is achieved in a similar manner to that for the case of single fault condition, namely, by these constraints being used to determine the values of the sequence currents flowing from the power system into the two points of fault.

2. NUMERICAL APPLICATION:

2.1. General

Rapid clearing of faults promotes power system reliability. The power which can be transmitted without loss of synchronism during a fault, is greater the more rapidly the fault is cleared. Indeed, increasing the speed of fault clearing is often the most effective and most economical way of improving the availability limit.

Rapid fault clearing is desirable for additional reasons. It lessens annoyance to electric power customers from flickering of lamps due to voltage dips and from shutting down of Motors through operation of undervoltage tripping devices. It also decreases the damage to overhead transmission-line conductors and insulators at the point of fault. Such damage is most likely to occur if the fault current is great, then with slow clearing, conductors may burn down or insulators may crack from the heat of the arc, giving rise to a permanent fault. With rapid clearing, on the other hand, the conductor is hardly damaged and the line can be put back into service immediately. The great majority of transmission line faults originate as one-line-to-ground faults. High-Speed clearing decreases the likelihood of such faults developing into more severe types, such as two-line-to-ground or three phase, through the arc being carried by the wind, from one conductor to another.

2.2. System opted for study

The network chosen in part(I) is also elected for study for this part of research. According to the data attained for 66 and 220 KV systems, the outage, operation times and the probability of forced outage for the different transmission lines are calculated. The probability of forced outage (q) is computed for the following types of faults:

a) Three phase, and three phase-to-ground fault.
b) Double phase-to-ground fault,
c) Single phase-to-ground fault.

2.3. Graphical representation through the six years of research and comments:

2.3.1. For 66 KV system:

The (reliability level (P)-years) characteristics of the various transmission lines for 66 KV system illustrate the variation of reliability level at a certain fault through the specified period. We have the following comments:

1. The three phase-to-ground fault characteristic has a higher reliability value than the other faults for the first and second transmission lines and has a lower reliability value than the second transmission line during 1975 and 1976 years.

2. Also the double phase-to-ground fault characteristic has a best reliability level, than that in the case of the single phase-to-ground fault, for the various transmission lines throughout all the years of research.

This is true except that is has a lower level than that belonging to the single phase-to-ground fault in the case of the second transmission line (L_2) during the years of 1971 and 1972 only.

However, for the third interconnector (L_3), this phenomenon occurs during the year of 1971.

3. There is a common important phenomenon which occurs for the three components (L_1, L_2 and L_3) of our network. This is summarised as follows:

The reliability level has a descending characteristic initiated from the first year of study (1971) and terminated by 1976. This variation takes the form of parabolic characteristic as displayed in figures (11), (12) and (13). The preceding phenomenon yields a great attention to the leaders of the general electrical network of this part since the reliability level decreases continuously when single phase-to-ground faults occurs.

4. On the other hand that is not true for the double-phase-to-ground fault since the probability of forced outage decreases i.e. reliability level increases against the various years of research except for (L_1).

5. Eventually, if we study the occurrence of the three-phase-to-ground fault, we can conclude that the reliability level decreases beginning with 1971 till 1976 except for (L_3), there is a slight ascending in the reliability level characteristic which is remarkable through 1976.

2.3.2. <u>For 220 KV System</u>

The (reliability level (P) against years) characteristics of the various transmission lines for the 220 KV system are shown in figures (14), (15), and (16). From these characteristics we can note the following remarks.

a. <u>Referring to (L_1)</u>:

1. The characteristics of (L_1) have the same shape of variation for the types of faults considered along the specified period of research. The three phase-to-ground fault has a higher and better reliability level than in the case of the other types of faults except for the years of 1972 and 1976.

2. Also, the double - phase-to-ground fault has a higher value than the single-phase-to-ground fault during the 1973, 1974

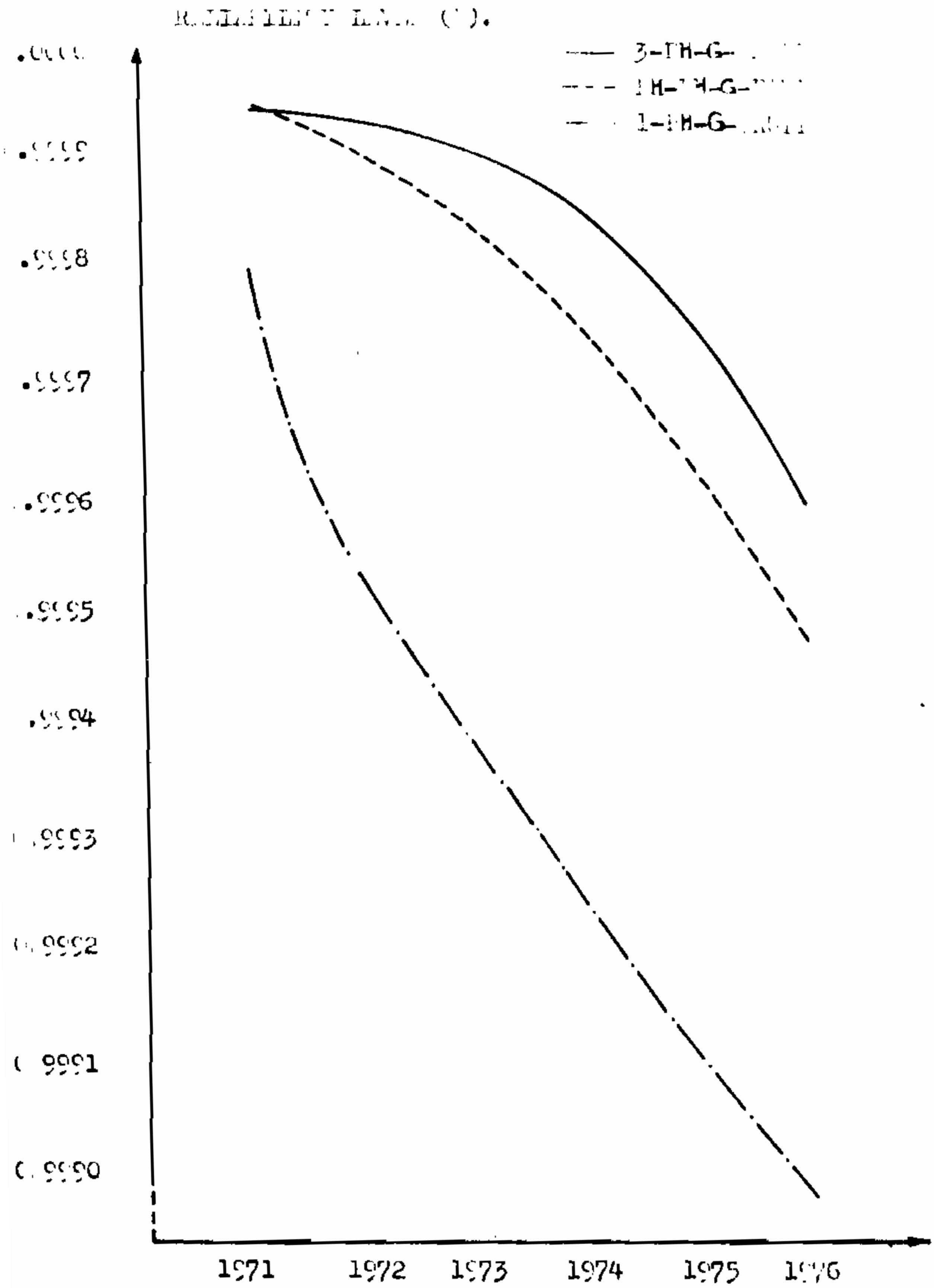

Fig. (11) THE RELIABILITY LEVEL (P) AGAINST YEARS CHARACTERISTIC OF THE FIRST TRANSMISSION LINE (L_1), (TALKHA - TANTA) FOR 66 KV SYSTEM.

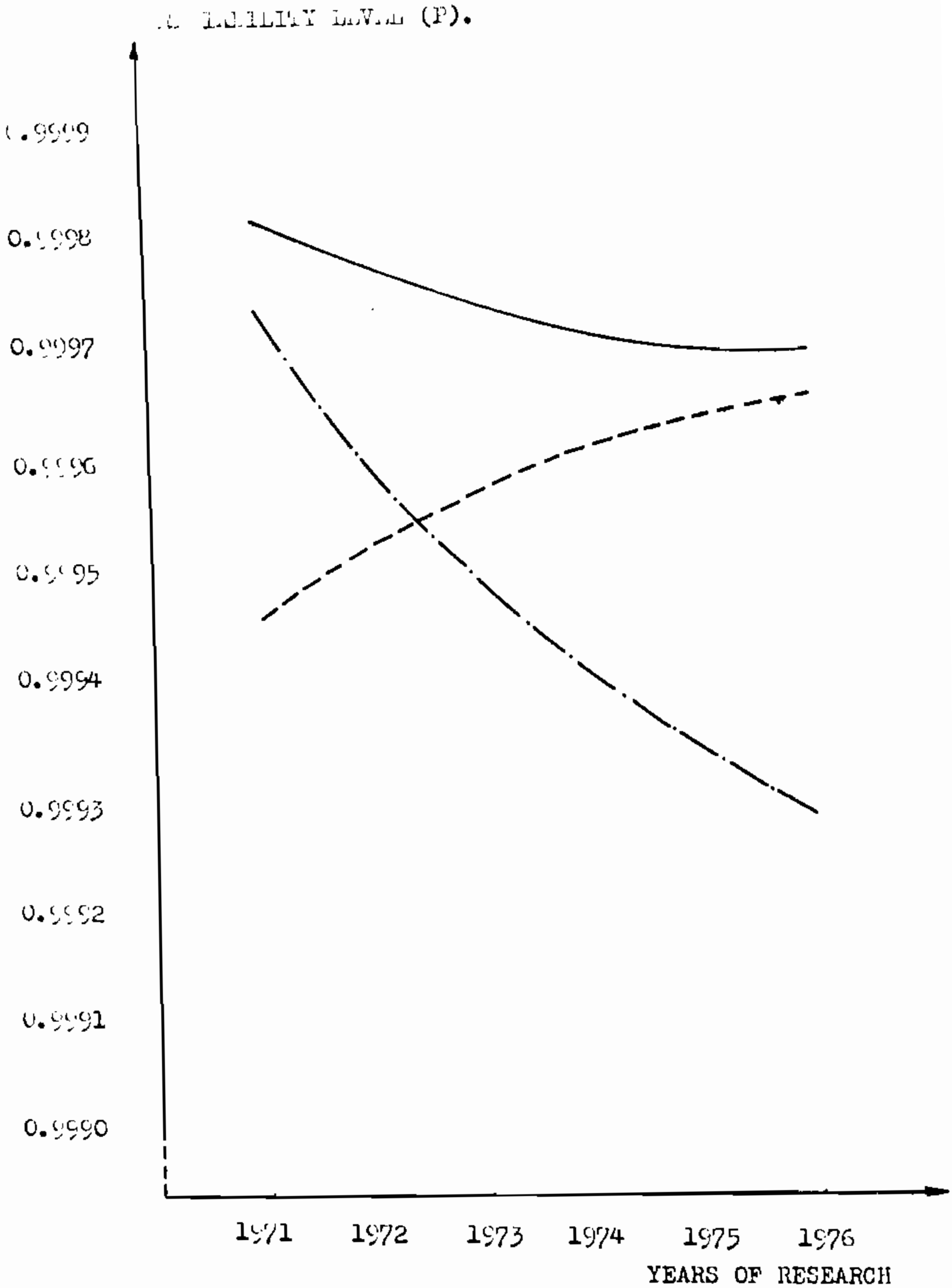

Fig. (12) THE RELIABILITY LEVEL (P) AGAINST YEARS CHARACTERISTIC, OF THE SECOND TRANSMISSION LINE(L_2),(TALKHA-EL-ZAGAZIG) FOR 66 KV SYSTEM.

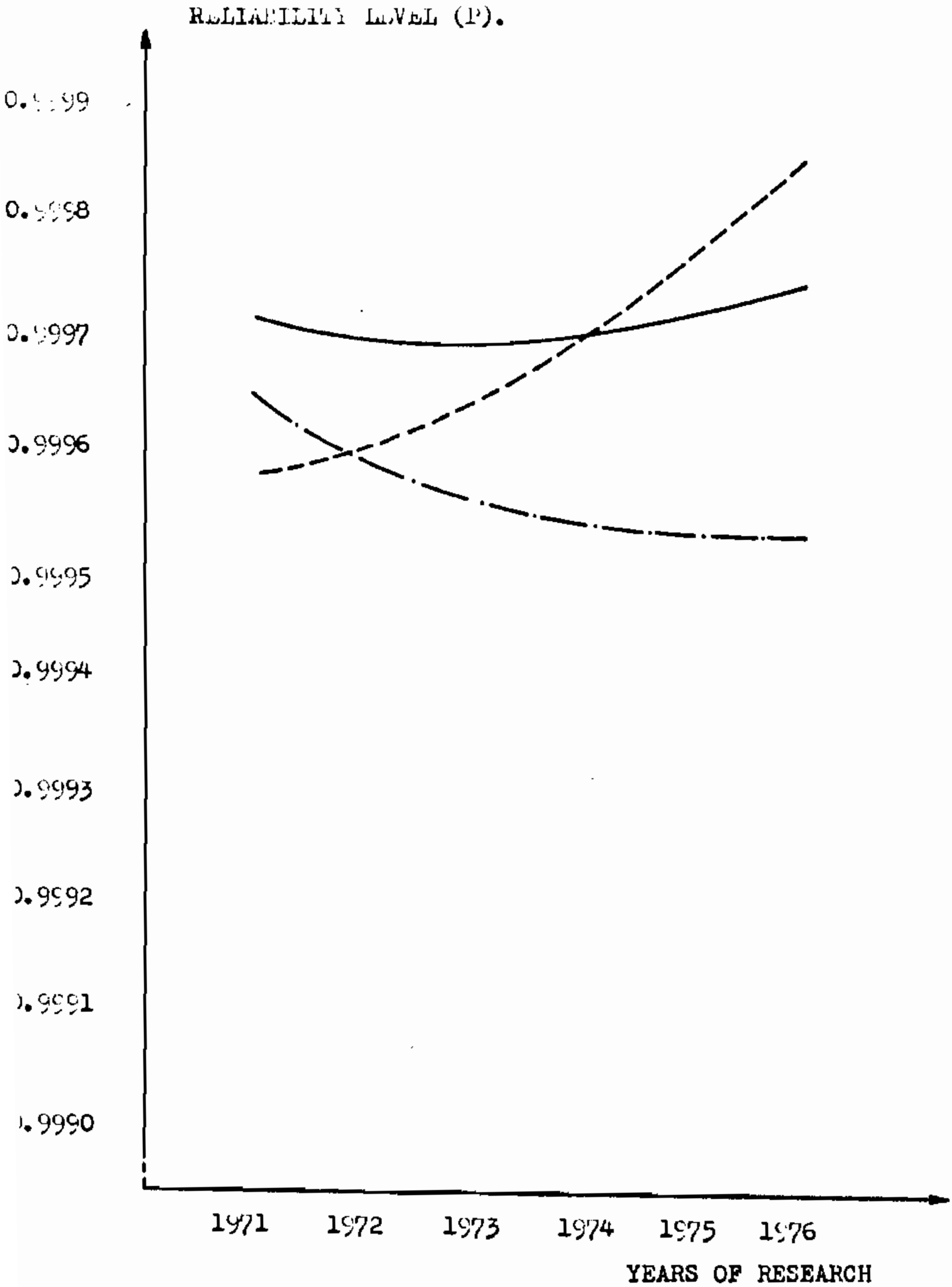

Fig. (13) THE RELIABILITY LEVEL (P) AGAINST YEARS CHARACTERISTIC, FOR THE THIRD TRANSMISSION LINE(L_3),(TANTA-DAMANHOUR) AT <u>66 KV SYSTEM</u>.

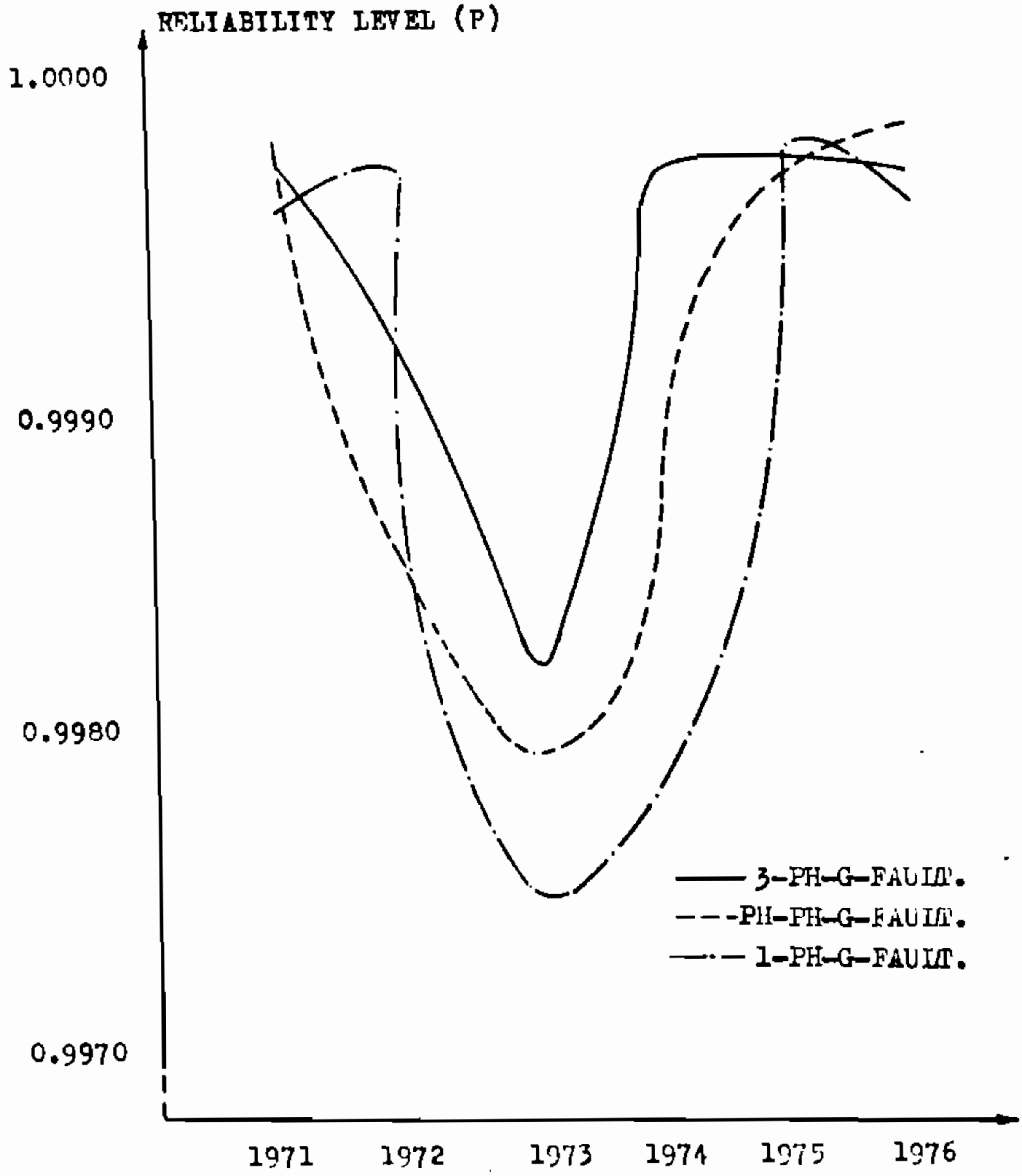

Fig. (14) The reliability level (P) against years characteristic, of the first transmission line (L_1), (Talkha - Tanta), for 220 KV.

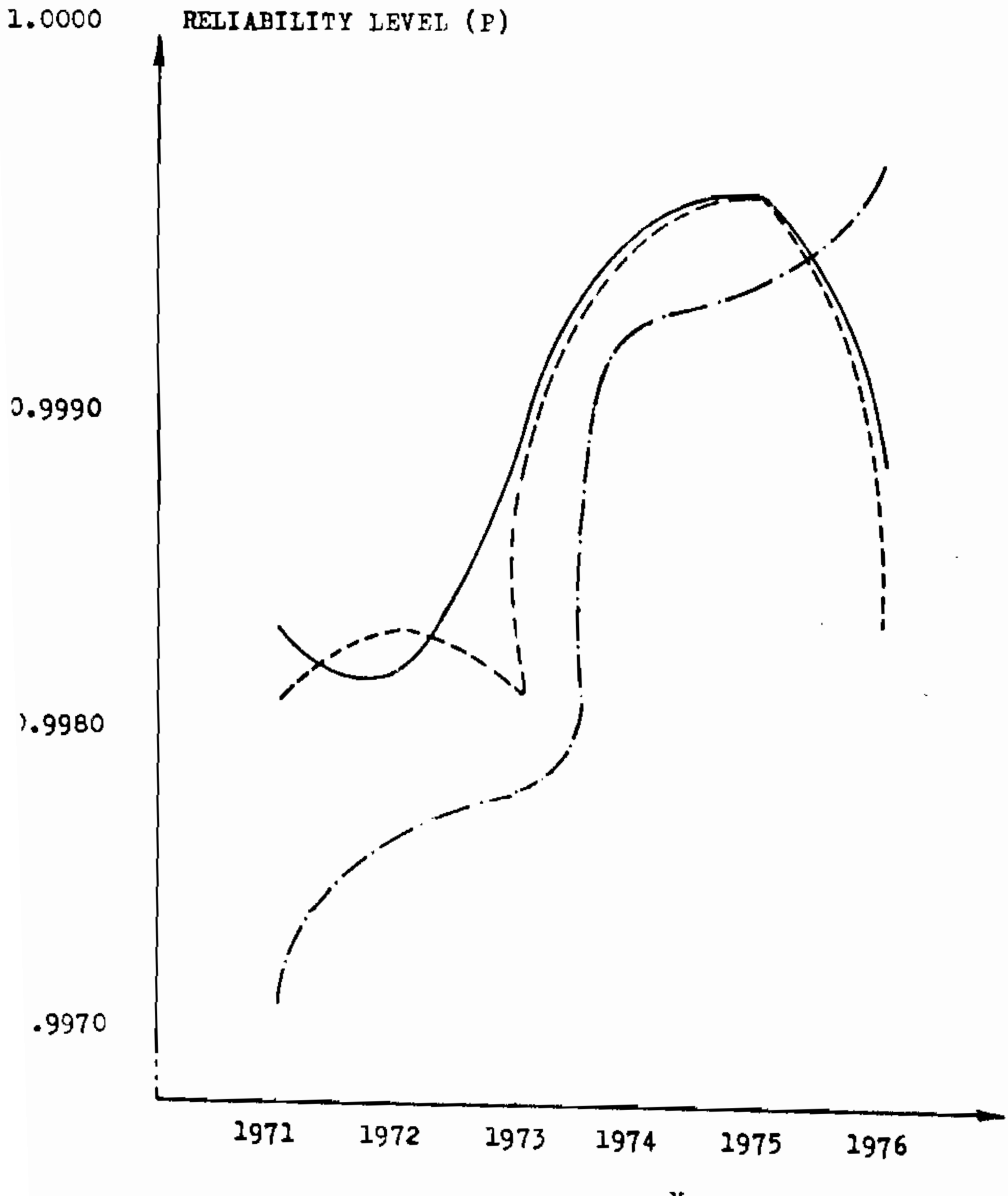

Fig. (15) The reliability level (P) against years characteristic, of the second transmission line (L_2), (Talkha - El-Zaggzic), for 220 KV.

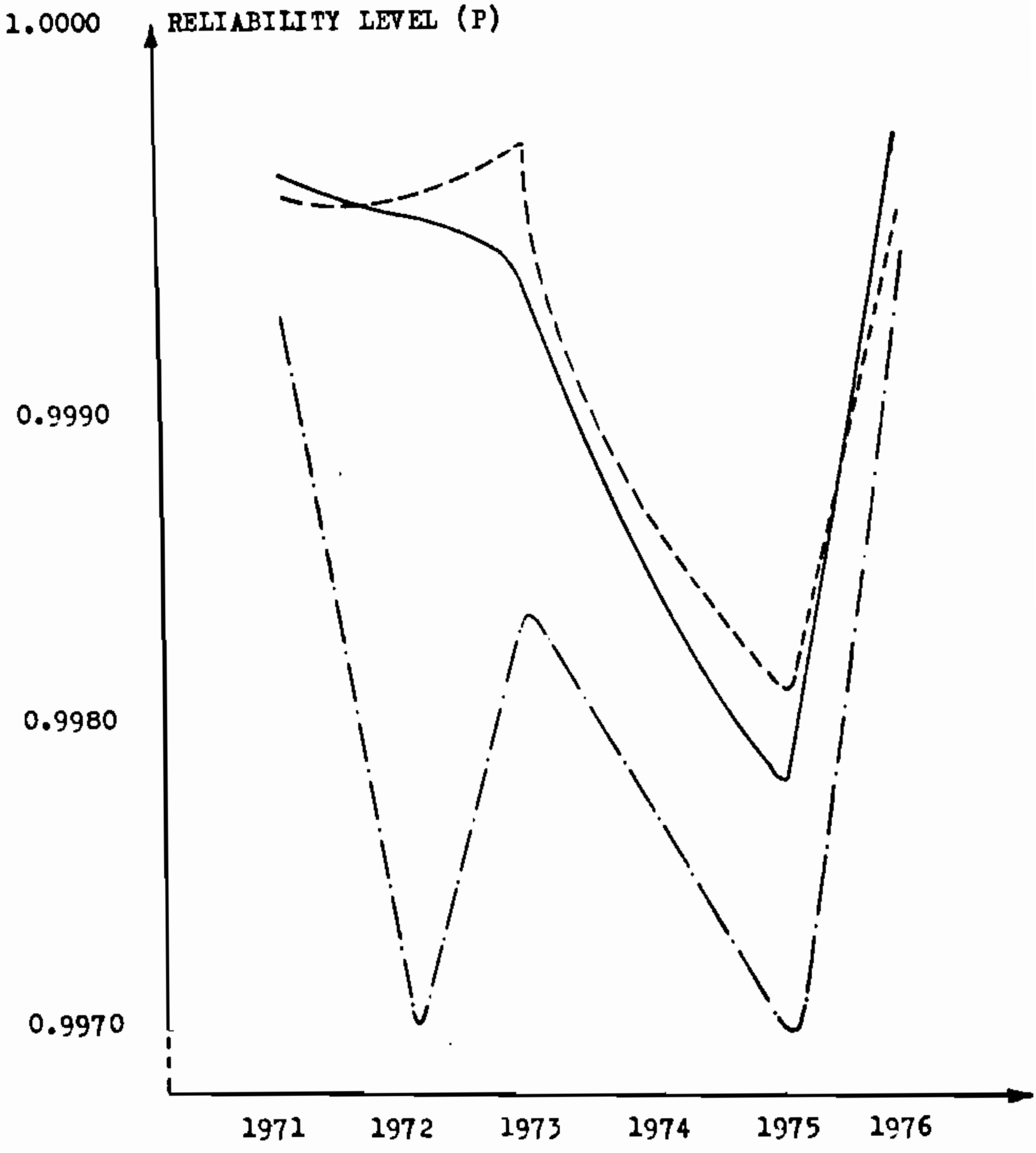

Fig. (16) The reliability level (P) against years characteristic, of the third transmission line (L_3), (Tanta - Damanhour), for 220 KV.

and 1976 years.

3. There is an intersection between the characteristic of double-phase-to-ground and the single-phase-to-ground faults during the 1972 and 1975 years. This means that (L_1) has the same reliability level (P) for the pre-mentioned faults. The characteristics have a minimum reliability level during the 1973 year . One of the most important reasons for this phenomenon is 6th October war and their circumstances.

b. Regarding (L_2)

1. For this line, the reliability level has irrigular variations. The characteristics for each of the three types of faults, have minimum level of reliability during various years. However, the characteristics have a good relibility during the other years. This is ascribed by the bad maintenance of this line during the first part of the six years of re-search which fact increases the capability of faults occurring.

2. The single-phase-to-ground fault has a higher and better reliability level ($P = 0.99986$) during the 1976 year than the other types of faults.

This is preferable from the practical point of view.

c. With respect to (L_3)

1. The three-phase-to-ground and the double-phase-to-ground faults have similar shape through the years of survey.

2. The characteristics of these faults have minimum reliability level during 1975 which means worst circumstances than in other years.

3. The double-phase-to-ground fault has a higher value than the other faults except during the 1971 and 1976 years.

4. The single-phase-to-ground fault has a low reliability level along the six years of research than the other faults.

The main cause for this phenomenon is due to the bad maintenance. Finally, we note that the single-phase-to-ground fault has a hazardous effect on all interconnectors for the major part of the interval taken for study.

Although the three-phase-to-ground fault has a higher and the best reliability level for L_1 and L_2 but for L_3 it has slight less level under the double-phase-to-ground fault characteristic.

3. CONCLUSIONS:

1. In the transmission system planning, the emphasis must of necessity be on technical rather than economic considerations. The necessity for high reliable and fully discriminative is absolute in the context of KV transmission systems.

2. Fault calculation forms an indispensable part of the whole function and process of power system design. Correct design depends essentially on a full knowledge, understanding of system behaviour and on the ability to predict this behaviour for the complete range of possible system conditions.

3. The reliability level for 66 KV transmission lines has good and high ratios for the three-phase-to-ground faults, and bad reliability level is attained by the single-phase-to-ground fault.

Dealing with the 220 KV system, the single-phase-to-ground fault has a dangerous effect on all lines for the six years of our research.

Also, the three-phase-to-ground fault has a higher and better reliability level for L_1 and L_2 but for L_3 it has slight le[illegible] level under the double-phase-to-ground fault characteristic.

BIBLIOGRAPHY:

1) The electricity council "Power System Protection". Vol. I & II, 1969.

2) Edward Wilson Kimbark, "Power System Stability" (Book), John Wiley & Sons, Inc. New York, London, Sydney, Publisher 1967.

3) William D. Stevenson, Jr. "Elements of power System Analysis" (Book), 1962.

4) A.El-Dean M. "Reliability of transmission system and factors affecting it" M.Sc. thesis. El-Mansoura Univ.

5) Roy Billinton "Power system reliability evaluation" Book. 1971.

6) Davies. "The relationship between weather and electricity demand" IEE 1958 P. 27.

7) D.Galiana "Identification of stochastic Electric load models from physical data". IEEE Trans. automatic control Dec. 1974.