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# China’s Practice on AtoN Maintenance Quality indicators

# Summary

This document introduces the current quality indicators and calculation methods of China MSA for the maintenance and management of coastal AtoN.

## Purpose of the document

The purpose of this document is to provide China’s practice on AtoN maintenance quality indicators to IALA and other national AtoN authorities.

## Related documents

IALA R0130 Categorisation and Availability Objectives for Short Range Aids to Navigation;

IALA G1035 Availability and Reliability of Aids to Navigation;

IALA G1004 Level of Service;

IALA ARM18 -12.1 Report of ARM18.

# Background

The 18th session of the IALA AtoN Requirements and Management (ARM) Committee was held from 15 – 25 April 2024. During the discussion of the agenda item 1.4.11 on “Develop measures for and a method to monitor waterway risk”, it was pointed out that “several countries deviate slightly on how to calculate AtoN Availability Rate(AAR)”, thus it was requested that participants provide AAR at ARM19 for review.

At present, the indicators and calculation methods of the maintenance quality of China's coastal AtoN are implemented in accordance with “Coastal AtoN Maintenance and Management Rules” issued by China MSA, and the indicators and calculation methods are not exactly the same with the calculation methods recommended in the G1035 -Availability and Reliability of Aids to Navigation. Therefore, it is necessary to share China’s practice in this regard in order to enhance the understanding of AtoN Authorities worldwide on the calculation of AAR.

# Maintenance modes and quality indicators of china’s coastal AtoN

Depending on the maintenance periods and contents, the maintenance of China’s coastal AtoN include four modes: Visual Inspection, Onsite Inspection, Major Repair and Emergency Repair. Visual AtoN maintenance should meet the overall goal of "Accurate Position, Normal Light, Bright Color, Sound Structure". Radio AtoN maintenance should meet the overall goal of “Accurate Signal, Stable Frequency, Normal Output, Continuous Operation”.

IALA G1004 takes the AAR as the key performance indicator of AtoN maintenance quality. Availability Rate is the probability that an AtoN or a system of AtoN is performing its specified function at any randomly chosen time, which is expressed as a percentage of total time that an AtoN or a system of AtoN should be performing their specified function. Based on risk assessment and navigational significance, IALA puts AtoN into three categories, and specifies the availability rates for each category, that is, 99.8% for Category 1, 99.0% for Category 2, 97.0% for Category 3. However, China MSA generally classifies the maintenance quality indicators of coastal AtoN into Normal Rate of AtoN and Normal Rate of AtoN Maintenance, which are short for the “Two Rates”. The Normal Rate of AtoN refers to the ratio of the amount of AtoN days maintaining normal to the amount of AtoN maintenance days in a region, which is an index that reflects the AtoN efficacy in a certain range and period. The Normal Rate of AtoN Maintenance refers to the ratio of the amount of AtoN maintenance days minus the amount of AtoN failure days which cannot be repaired within a specified time and the amount of AtoN maintenance days in a region, which is an index that reflects the AtoN maintenance quality in a certain range and period. China MSA does not classify AtoN according to navigational significance, but stipulates that the Normal Rate of AtoN should not be less than 99.0%, and the Normal Rate of AtoN Maintenance should not be less than 99.5%.

# calculation methods and example of the “Two rates”

# Normal Rate of AtoN

The math expression of Normal Rate of AtoN is expressed by equation (1):

 (1)

Where, P is the Normal Rate of AtoN; S is the amount of AtoN maintenance days, that is, the product of the number of AtoN and the number of maintenance days; and M is the amount of failure days, that is, the sum of days of all AtoN failure.

Notes: 1. The calculation of AtoN days is firstly calculated to the hour, then converted into the day in proportion. 2. If any of the AtoN fails to be repaired in time for any reason, the failure time shall be included in the calculation of this indicator.

# Normal Rate of AtoN Maintenance

The math expression of Normal Rate of AtoN Maintenance is expressed by equation (2):

 (2)

Where, P’ is the Normal Rate of AtoN Maintenance; S is the amount of AtoN maintenance days; and B is the amount of AtoN failure days beyond the repair time limit.

Notes: 1. The calculation of AtoN days is firstly calculated to the hour, then converted into the day in proportion. 2. The repair time limit is determined by the types of AtoN failure. The repair time limit is 48 hours for Light Extinguished, Error of Light Characteristic, Structural Failure, Suspension or Error of Radio Signal; the repair time limit is 72 hours for Out of Position, Missing, Serious Structural Failure. Hence, if the time limit for an AtoN failure is 48 hours, which in fact is repaired 60 hours after failure, then B=(60-48)/24=0.5. 3. The amount of AtoN failure days that exceed the repair time limit due to maintenance facilities and personnel unable to arrive at the scene arising from weather reasons such as heavy wind and waves are not included in the calculation of this indicator.

# calculation example

In order to better understand the calculation methods of the “two rates”, the statistical data of the Lian Yungang AtoN Division in January 2024 was taken as an example to calculate the “two rates” . The relevant data are shown in Table 1.

1. AtoN Operational Statistics

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Name | Types of AtoN failure | Failure Time | | | Repair Time Limit | Failure Hours Beyond Repair Time Limit | Failure AtoN Days Beyond Repair Time Limit |
| Failure confirmed ～Repair confirmed | Time in Hours | Time in AtoN Days | 48h/72h |
| 1 | X1 Buoy | Out of Position | 4th Jan 16:23～  7th Jan 11:23 | 67.0 | 2.79 | 72h | 0.0 | 0.0 |
| 2 | X2 Buoy | Missing | 12th Jan 16:10～  15th Jan 13:05 | 68.9 | 2.87 | 72h | 0.0 | 0.0 |
| 3 | X2 Beacon | Light Extinguished | 21st Jan 14:10～  24th Jan 17:30 | 75.33 | 3.14 | 48h | 27.33 | 1.14 |
| Total Amount | —— | —— | —— | 211.23 | 8.8 | —— | 27.33 | 1.14 |

As of the end of January, the total number of AtoN under the jurisdiction of Lian Yungang Navigation AtoN Division was 1068 (excluding DGNSS stations and AIS base stations), there are 31 natural days in January, the amount of AtoN failure days was 8.8, and the amount of AtoN failure days beyond repair time limit was 1.14. Therefore, the calculation of the “Two Rates” of AtoN in January is as follows:

Normal Rate of AtoN:



Normal Rate of AtoN Maintenance:



# Conclusion

The calculation logic of the Normal Rate of China's coastal AtoN and the IALA AAR are basically the same, but there are differences in calculation methods. IALA recommends that the Availability of a single AtoN or system of AtoN is calculated over a three-year continuous period. The advantage of this calculation method is that it has strong pertinence and can truly reflect the individual differences of a single AtoN. However, the Normal Rate of China's coastal AtoN is calculated by taking all short-range navigational marks in a certain region as a whole to calculate for one month and one year. The advantage of this calculation method is that the calculation is simple, and it can reflect the overall working efficacy of all short-range AtoN in a certain region, and it is not affected by the "Bathtub Curve" effect of a single AtoN, which will cause decline or abnormal fluctuations of AAR.

There is no maintenance quality indicators corresponding to the Normal Rate of AtoN Maintenance in the IALA guidelines. The Normal Rate of AtoN Maintenance is the extension and supplement of the Normal Rate of AtoN. The level of its indicator reflects the emergency response capability of AtoN authorities on the one hand, and the maintenance quality and service level of AtoN authorities on the other hand.

# Action requested of the Committee

The Committee is requested to note the information of this document.

1. China’s Practice on AtoN Maintenance Quality indicators [↑](#footnote-ref-1)