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Agenda item [2] 9.2

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Author(s)/Submitter(s) China MSA

TESTING OF VTS INFORMATION SERVICE BASED ON VDES

1. BACKGROUND

According to Section 3.1.1 of Resolution A.1158(32) on *Guidelines for Vessel Traffic Services*(VTS) of the International Maritime Organization (IMO), the purpose of VTS is to provide vessels with timely and relevant information on factors that may influence ship movements and assist on-board decision-making. This information facilitates the reduction of unsafe conditions within the VTS area, thereby promoting maritime safety of life at sea, enhancing navigational safety and efficiency, and supporting environmental protection. The information includes the vessel's location, name, intention, and movement, as well as maritime safety information, etc[1].

According to the concept of Maritime Service (MS) proposed in the context of IMO's E-Navigation [2], the aforementioned information can be categorized under MS1 and digitally characterized using the guidance for Application Specific Messages (ASMs) provided in the IMO Circular SN.1/289, thereby facilitating a comprehensive digital representation of maritime service information. On this basis, China Maritime Safety Administration (MSA) has recently carried out an attempt to exchange the shore-ship VTS information service through VDES. By cooperating with manufacturers, configuring VDES base stations and ship-borne equipment, adapting electronic chart terminals, and connecting with VTS management platform, China MSA has realized broadcasting hydrological and meteorological information and transmitting navigation warning information based on geographical multicast, and has carried out onboard test in the waters of Tianjin Port. The digitalized VTS information, including maritime safety and meteorological information, is visually presented on ECDIS in a user-friendly manner, thereby confirming the reliability of VDES-based services in delivering VTS information service. This is in line with the good practice of VTS and ships to achieve information transmission through data exchange and automated reporting, where feasible, to reduce management burden, information overload and information transmission error, and to simplify work procedures and enhance navigation safety[3].

2. PURPOSE

The purpose of this document is to bring to the attention of the VTS Committee by providing the application results that China MSA has realized on VTS digital information service transmission based on VDES, and to provide support and reference for the development and application of VDES in the VTS field.

1 Input document number, to be assigned by the Committee Secretary

2 Leave open if uncertain

3. COMPOSITION OF THE TEST

3.1. THE FRAMEWORK OF THE TEST BED

The test bed is designed according to the IALA CSSA framework, including the shore-based part and the ship-end part, as shown in Figure 1.

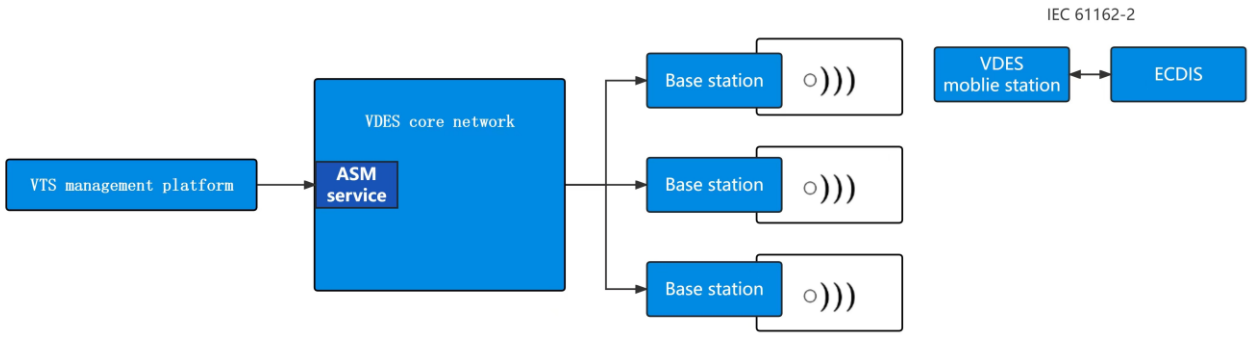

Figure 1 VTS service test bed framework based on VDES

In the shore-based part, the VTS management platform, as the source of VTS information service, is connected with the VDES core network. At present, China's VDES core network is under development and can provide basic VDE-ASM services. The VTS management platform first encodes VTS information services into a specific format, and connects to the VDES shore-based system through the ASM interface of the VDES core network, enabling data interoperability related to VTS information service. The VDES core network can control and manage multiple connected VDES stations, realizing the reception and routing of AIS, ASM, and VDE data packets, and controlling VDE signaling. The exchange of information between ship and shore is executed through the VDES air interface. Data packets of VTS information services are sent to the ship borne equipment after being encoded and modulated at the air interface of the VDES base station, ensuring effective data interchange.

On the ship side, the VDES mobile station encapsulates the data received from the air interface into sentences compliant with IEC PAS 63343, and through a serial port that meets the IEC 61162-2, achieves interoperability with ECDIS equipment. The ECDIS, after decoding the received data, displays it in either graphical or textual format.

3.2. TEST METHODS

Navigation warning information, meteorological information, and hydrological information are selected for the test.

To realize the graphical display of VTS information services on ECSIS, data transmission must be carried out in machine language. Currently, there are two organizational modes for machine language: S100 and structured message. Considering the rigorous data structure of VTS information services, in this test, we employed structured messaging to achieve higher transmission efficiency. Due to the limited message bits, the VDE-ASM channel(2027&2028) is used in the test.

In accordance with ITU Recommendation 2092-1, ASM utilizes seven types of messages to achieve data transmission from shore to ship, ship to shore, and ship to ship. The details of the seven types of messages are shown in Table 1:

Table 1 ASM information types

Messages	Name	Description
0	Broadcast AIS ASM Message	Encapsulated AIS ASM messages.
1	Scheduled Broadcast Message	Broadcast data using communication state.
2	Broadcast Message	Broadcast data with no communication state.
3	Scheduled Individual Addressed Message	Individual addressed data with communication state. Requires acknowledgement.
4	Individual Addressed Message	Individual addressed data with no communication state. Requires acknowledgement.
5	Acknowledgment Message	Used to provide acknowledgment for one or more addressed messages.
6	Geographical Multicast Message	Addressed to a group of stations defined by their geographical location with no communication state. No acknowledgment required.

In light of the characteristics of information services tested, navigation warning utilizes geographical multicast message (message 6). This ensures that vessels within a designated area can receive these alerts while avoiding interference from irrelevant information for ships in other areas. Meteorological and hydrographic information, on the other hand, utilizes broadcast messages (message 2), allowing all vessels within the signal coverage area to obtain the information.

On the ship side, the ECSIS device is modified to decode the payload according to IEC PAS 63343. It graphically displays the received information or provides text in optional languages.

3.3. PREPARATION OF STANDARDS FOR THE TRANSMISSION OF INFORMATION

At present, ASM can be categorized into two types: AIS-ASM and VDE-ASM. AIS-ASM uses AIS channels 87B and 88B for broadcasting, employing AIS messages 6 and 8. On the other hand, VDE-ASM uses channels 2027 and 2028 for transmission. Both types of ASM information share the same identification methods and message structures, with the message type defined by the DAC and FI fields. DAC values 1-9 are applicable internationally, while DAC 10-999 can be used regionally by national authorities. The FI defines the specific function type, as shown in Table 2:

Table 2 Structure of ASM messages

Bit	Description
10	Designated area code (DAC). This code is based on the maritime identification digits (MID). Exceptions are 0 (test) and 1-9 (international). While 10-999 are maintained by the regional authorities. Although the length is 10 bits, the DAC codes equal to or above 1 000 are reserved for future use.
6	Function identifier (FI). The meaning should be determined by the authority which is responsible for the area given in the designated area code.
variable	Payload

Currently, IMO IMO SN.1/Circ.289 has defined AIS-ASM information (DAC = 1-9) and allows national authorities to formulate regional AIS-ASM information formats. In consideration of protecting AIS VHF data link(VDL), this test adopted the VDE-ASM. Due to differences in the payload bit count, and given that the data format in IMO SN.1/Circ.289 has not been optimized for VDE-ASM, we utilized DAC=412 to define regional messages and developed data formats to adapt to VDE-ASM message. For instance, the format we defined for meteorological information is illustrated in Table 3.

Table 3 Meteorological information format

Parameter	Bit	Rule
DAC	10	412
FI	6	01
Forecast time	5	0 to 23, with the hour as the forecast point
Weather phenomena #1	5	Weather phenomenon codes range from 1 to 31 (see Table 7), beyond the range is invalid
Longitude #1	13	Unit: minute, range: 60 ° E to 180 ° E, base 60 ° E, the interval is 1'
Latitude #1	13	Unit: minute, range: 50 °S to 70 °N, base 50 °S, the interval is 1'
Wind speed #1	7	Unit: section, range: 0kn to 120kn, beyond 120kn is invalid
Wind direction #1	9	Unit: degree, range: 0 °~359 °, beyond the range is invalid
Air temperature #1	11	Unit: degrees Celsius, range: -60.0 °C to 60.0 °C, the interval is 0.1 °C, beyond the range is invalid
Air Pressure #1	9	Unit: hPa, range: 800 hPa to 1 200 hPa, base 800 hPa, the interval is 1 hPa
Visibility #1	8	Unit: nautical mile, range: 0.0 nm to 25.0 nm, the interval is 0.1 nm
Weather phenomena #n	5	Weather phenomenon codes range from 1 to 31 (see Table 7), beyond the range is invalid
Longitude #n	7	Unit: minute, range: 60 ° E to 180 ° E, base 60 ° E, the interval is 1'
Latitude #n	7	Unit: minute, range: 50 °S to 70 °N, base 50 °S, the interval is 1'
Wind speed #n	7	Unit: section, range: 0kn to 120kn, beyond 120kn is invalid
Wind direction #n	9	Unit: degree, range: 0 ° to 359 °, beyond the range is invalid
Air temperature #n	11	Unit: degrees Celsius, range: -60.0 °C to 60.0 °C, the interval is 0.1 °C, beyond the range is invalid
Air pressure #n	9	Unit: hPa, range: 800 hPa to 1 200 hPa, base 800 hPa, the interval is 1 hPa
Visibility #n	8	Unit: nautical mile, range: 0.0 nm to 25.0 nm, the interval is 0.1 nm
Sources of information	3	1: China Meteorological Administration, 2: China Oceanic Administration, 3: China Maritime Safety Administration, 4 to 7 reserved
Spare fill bit	0 ~ 7	
Total number of bits	99+ (n-1) *63+ (0~7)	
Note: negative codes are represented by a complement		

By introducing a flexible looping structure, the length of VDE-ASM payload data is variable, thus ensuring the efficiency of broadcast information dissemination. Similarly, the data formats for hydrographic information

and navigation warning information were also defined for the test. These data formats will be submitted to the IALA secretariat for presentation at https://www.iala-aism.org/asm/.

To enhance the successful transmission ratio of broadcast information, the test did not use the MITDMA transmission mechanism but transmitted once across a maximum of three slots. For broadcast messages, up to 1320 bits can be transmitted, while for regional broadcast information, up to 1248 bits can be transmitted.

3.4. TEST PROCEDURE

During the test, VDES base stations were installed at VTS facility located at Dongtudi, Caofeidian, Nangang, and the offshore Dagu Lighthouse, employing equipment from two different manufacturers, VDES base station in Dongtudi VTS center is shown in Figure 2:

Figure 2 VDES base station installed at the VTS Center

A patrol boat was equipped with the test devices and followed the route depicted in Figure 3 for the purpose of testing along the way.

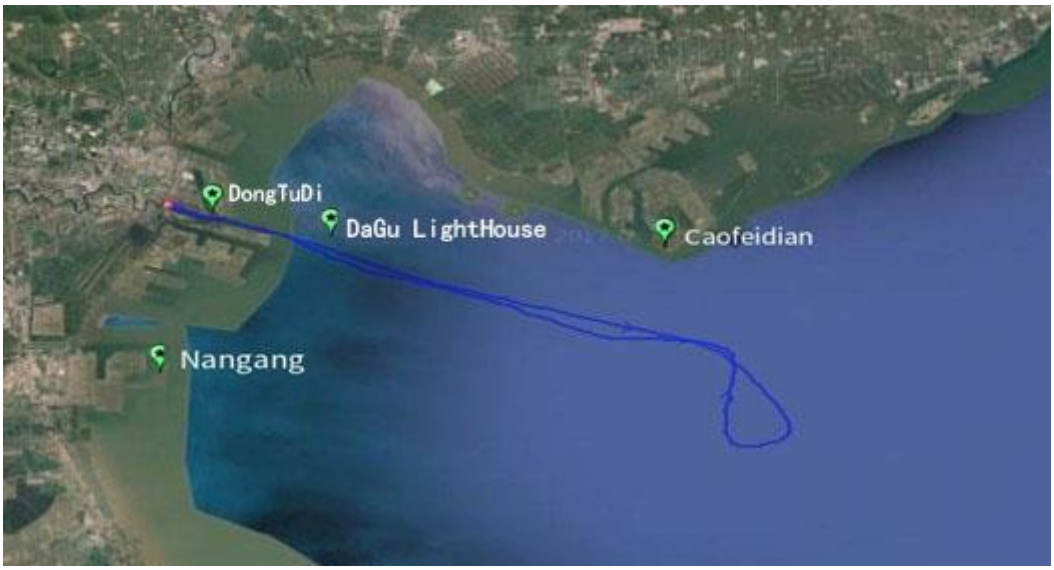

Figure 3 Test route

For navigational warning information, a geographic multicast was adopted, with a range of 30 nautical miles around the warning location, ensuring timely access to information when a vessel approached the warning

location. As shown in Figure 4, the red area represents the navigation prohibited waters, and the green area represents the geographic multicast effect area.

Figure 4 Area for Geographical Multicast

3.5. TEST RESULTS

Through the testing, it was determined that the VDES ship terminal could normally receive the navigational warnings, hydrological and meteorological information sent by the base station, and the ECDIS device was also able to accurately parse and display this information. This functionality is illustrated in Figures 5, 6, and 7.

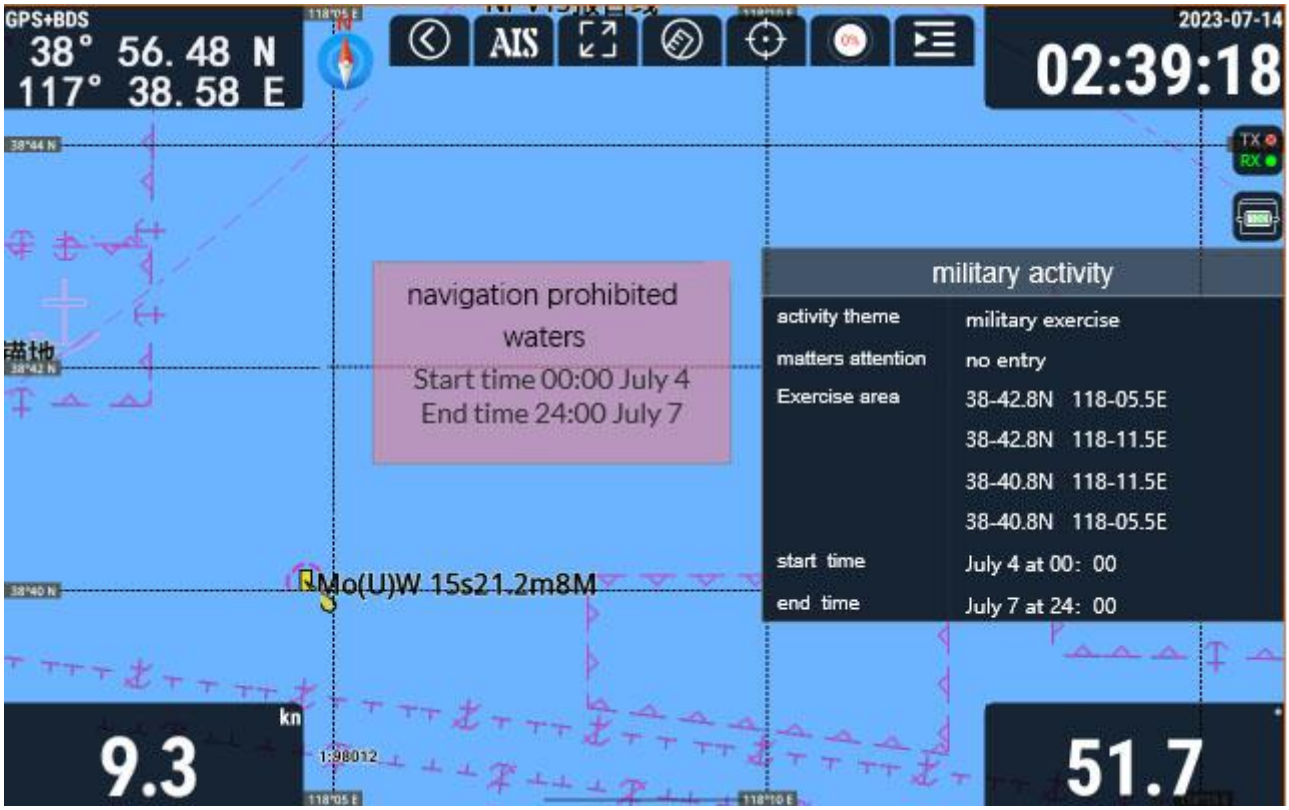

Figure 5 Navigation warning information displayed by ECDIS

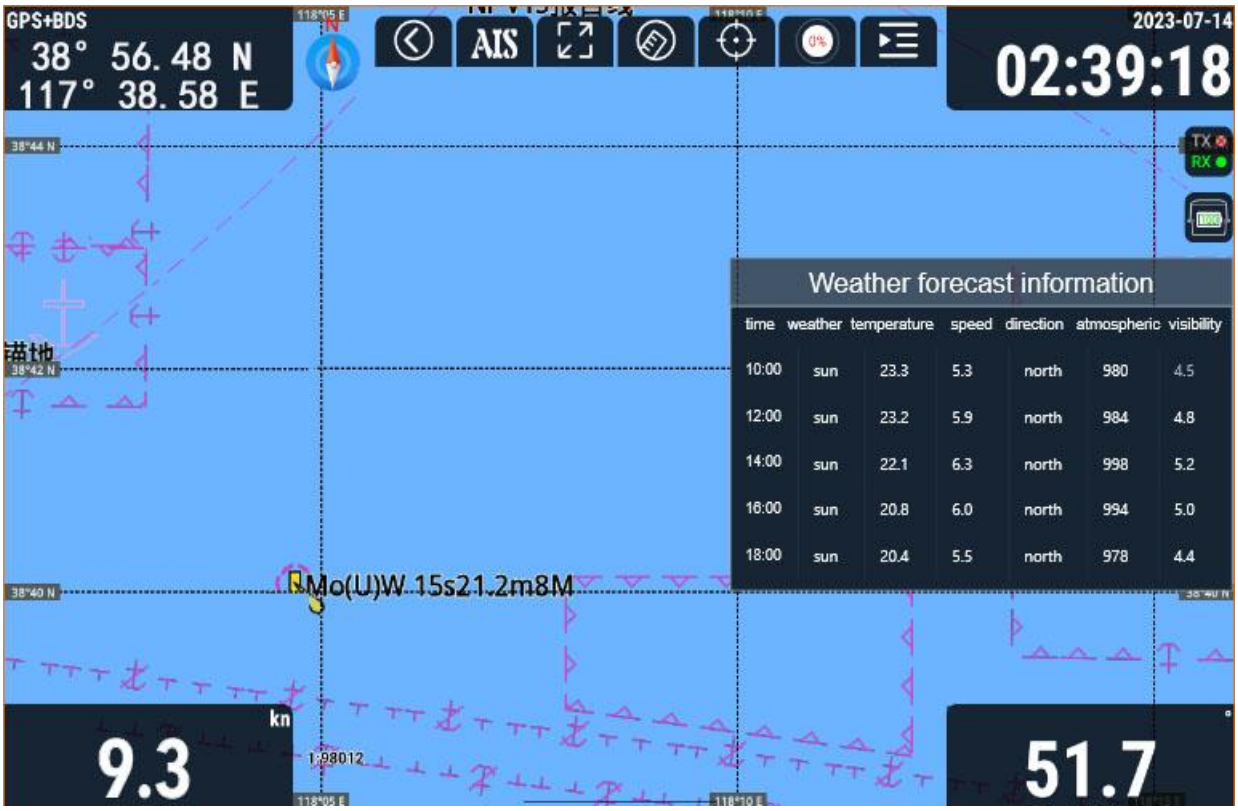

Figure 6 Weather information displayed by ECDIS

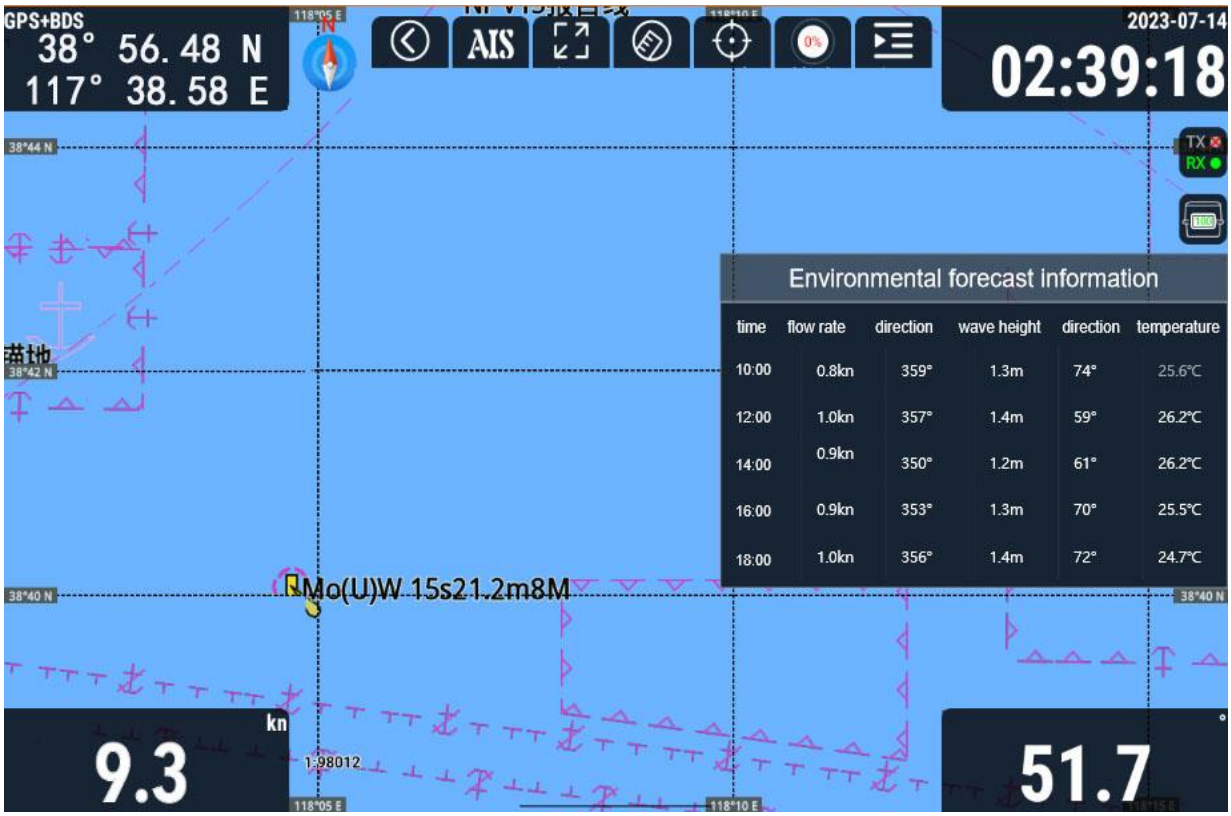

Figure 7 Hydrologic information displayed by ECDIS

4. FOLLOW-UP WORK

The current testing focused on navigational warnings, hydrological, and meteorological information services of VTS information services. In the future, China MSA will conduct tests that include other VTS information service, navigational assistance service, and traffic organization service. Considering that navigational assistance and traffic organization services require more flexible information organization methods and larger data transfer volumes, we will exchange data based on the S100 format by VDE-TER in these tests.

Given the transmission mechanism of VDE-TER, the test team has planned the service area for the Tianjin Port VDES base station (as shown in Figure 8), in hopes of completing the networking of the VDES base station by upgrading the VDES core network, further realizing the mobile management of ships during cross-service area navigation.

Figure 8 Service area planning of VDES base station in Tianjin Port

5. REFERENCES

[1] IMO A.1158(32) - Guidelines for Vessel Traffic Services, 2022(1).

[2] IMO MSC.1/Circ.1610 -- E- Initial Description of Maritime Services in the Nautical Context, 2019(6).

[3] IALA Guideline1089 -- Providing Ship Traffic Services, 2022(1).

6. ACTION REQUESTED OF THE COMMITTEE

The committee is requested to note the information provided.