Flight Inspection and Procedure Design

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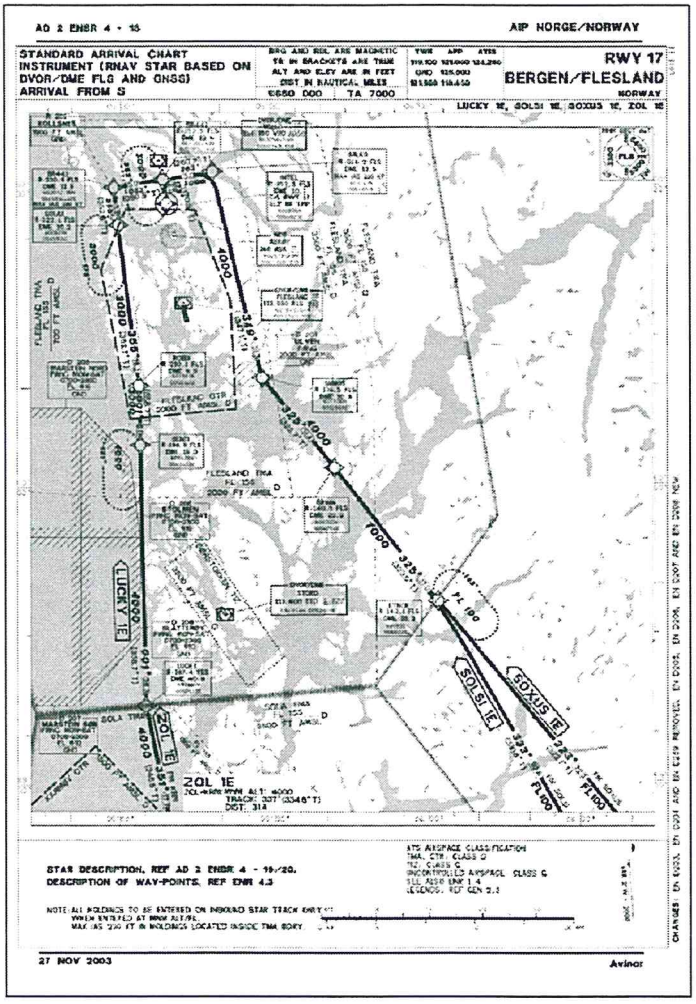
ABSTRACT



Checking of new and existing Instrument Flight Procedures (IFP) is becoming a major part of all flight inspection activities.

Modern flight inspection systems, capable of simultaneous data acquisition, calculations of several navigational aids, ARINC 424 database management, moving map applications and highly advanced pilot guidance systems should be used to verify and quality assure the end result before publishing a new procedure.

Output from procedure design tools may be used directly in advanced flight inspection systems as input aimed at verifying the desired performance of the procedure. This will be an added help to procedure designers so that the procedure itself will take into account real flight data, not just simulated.

This paper will present a system and a concept developed to work effectively in this highly challenging mix of old matured technology and the new integrated technology introduced. It is a FI industry challenge that is arising as the biggest in decades.

BACKGROUND

Innovation is an important factor in today's competitive FI manufacturer world. Practical discussions around the Inspections of pre published / new developed IFhave been discussed for many years. Practical solutions have been found. Initiating the work is typically the requirement to maximize the utilization of the airspace further by introducing new routes. Tools are used by the designers to evaluate the current routes, develop new routes and add new Communication Navigation Surveillance (CNS) elements if necessary. So far the data used is typically not real life data, but very good simulations, calculations and estimations done manually or by advanced type of software. The result of this analysis will show the airspace designers what would be needed to add in order to satisfy the requirements and recommendations in the [ICAO PANS OPS & 9368] and [FAA TERPS] manuals of airspace design. The airspace designers would often cooperate or be integrated with one Graphical Information Systems (GIS) department or unit to be able to publish the described procedures on an aeronautical chart and in text format. The official publishing of the Aeronautical Information System (AIS) data would not be done before the new procedures have been evaluated. Typically the evaluator for new procedures is a FI unit with an FI aircraft with qualified and trained personnel and with proper documentation routines to store this data for later analysis or for pure quality control. Or maybe this is not the case?

TODAY'S TYPICAL SCENARIO FOR CHECKING OF NEW IFP

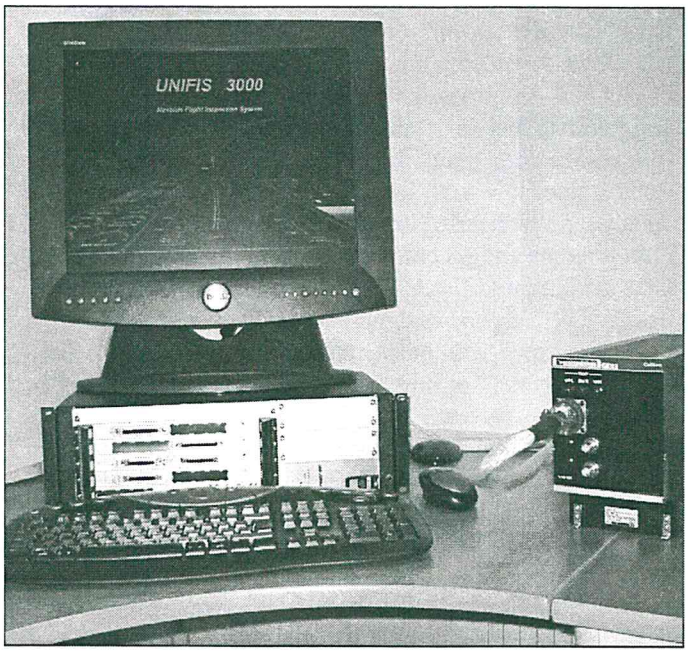
Receiving The Task

By internal mail, by fax by or other means, the chart and or description arrives on the desk of the responsible Flight Inspector. This might be a pilot or a FI operator. The evaluation starts here, with the knowledge and the

experience of the individual FI or as a larger team. I would like to state that it is our opinion that from the start of the design to this point, there are a lot of paths that will arrive to the same procedures, even though the methods and the time to get there varies a lot.

We are equally convinced that from this point on, the variations in solution around the world are way too many and often becomes a evaluation based on subjective personnel opinion. We also will claim that this is due to lack of sufficient tools, and of a totality in the process.

Is the procedure received correctly?



Setting Up For A Mission – Configuration –

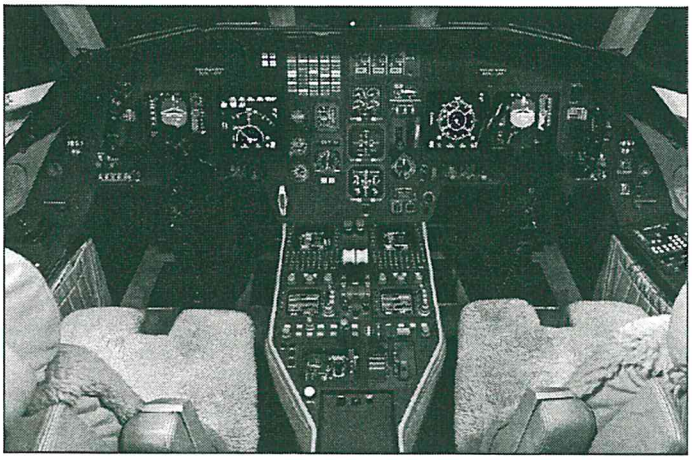
How to configure the aircraft & systems for the new procedure?

A typical scenario is that the pilot will fly the procedure as described, either manually or automatically. If the pilot flies it automatically, he has either inserted the data into the FMS or he has loaded a special data card into the aircraft systems.

The FI system is often not utilized at all. Some setup the systems for DME inspections other systems inspect one Navaid only.

The result of such an inspections are typically a hand written log from the Flight Inspection Pilot.

Is the data inserted correctly into the FMS? Is the data inserted correctly into the FI system? Will the FMS fly a procedure equally if entered manually v.s from a datacard? Is the evaluation of other warnings such as GPWS or other systems taken into considerations? Is the procedure flown out to its boundaries?



In Flight – Guidance

Flying the procedure auto coupled with integrated Flight Management Systems (FMS) with database is essential. This will represent the majority of the aircraft using the procedure. The aircraft should be certified to fly the type of procedure that is to be inspected.

Flown manually or coupled? How was this documented? What happens if one navaid is u/s? How to evaluate this?

Evalutation – Results

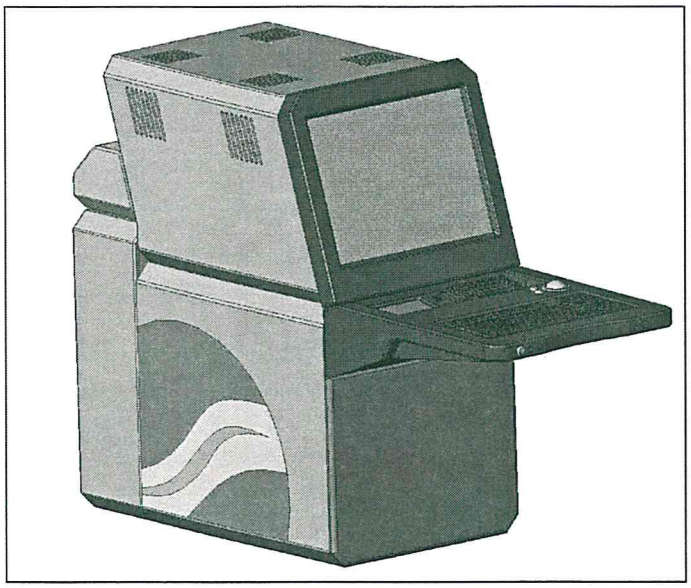
It is our opinion that inspection of a new IFP is a highly complex task. The elements involved is such that it demands complex systems to handle all the information needed. It is therefore not less of a challenge for a system or an organization to evaluate it. The IFP is therefore often divided into several inspections in time. (example: each CNS elements are inspected separately in time)

Could the procedure be flown or not? Were the waypoints correct? Was the accuracy of the CNS elements satisfactory for the procedure type? Can you document this?

ONE POSSIBLE SOLUTION – THE UNIFIS 3000

Norwegian Special Mission company faced a unique opportunity in 2003. The requirement of the UNIFIS 3000 was laid down, and the unique knowledge of a highly experienced FI Systems design team could look at the above scenarios and write the design specifications as part of the total solution.

- Key additions to traditional methods of inspection can be summarized to Integration with FMS
- Database
- Documentation
- Inspection and time & Calendar date.
- Certification



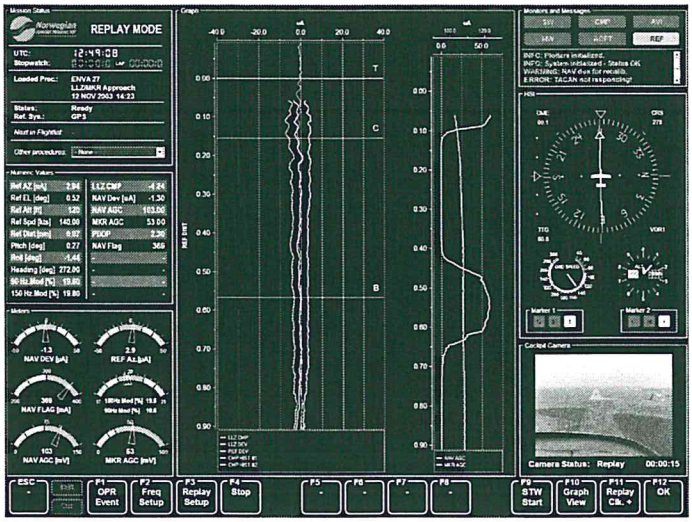
Here is some of the solutions that were included into the design:

Linking the Procedure Design Tool with the UNIFIS 3000 Server System

The USS is a specially design laboratory computer with some unique features. It enables the operator to plan and transfer missions to the aircraft. It automatically downloads flown missions from the airborne UNIFIS 3000. It distribute the data on the UNIFIS 3000 web server. It serves as the backup server for the FIS data using RAID solutions. As a recommended option, the suite of Procedure Design tools can be installed on the USS. The integration with the IFPDT to the UNIFIS is through the ARINC424 data base format as of Aug. 2004. The database will be transferred directly to the airborne UNIFIS 3000 through the USS.

The UNIFIS 3000 database is unique. The ARINC 424 interface is developed by NSM. The reason for not running directly on the A424 is that the UNIFIS 3000 database needs to be encrypted for military applications, it need to contain more accurate data, different data and it has a standard 32 bits CRC. The SEMI manual approach is to insert the finished procedure definition file into the USS via disk, USB key or via email. The file conversion is part of the service that the manufacturer of the UNIFIS 3000 does. If the data is not available electronically at all, the Procedure Design interface on the USS will enable you to define your waypoints.

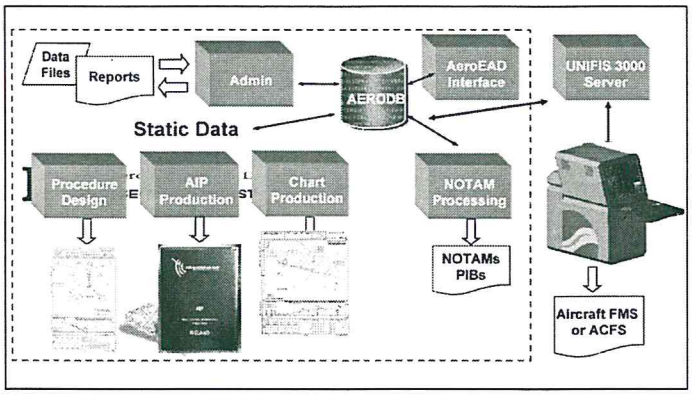
It ensures that the data from IFPDT would be transferred more easily and with higher degree of QA.



UNIFIS 3000 – IFP setup.

The UNIFIS 3000 receives the data wireless from the USS or a portable PC. The system automatically uses the data sent from the IFPDT to select the CNS elements to be inspected and if enabled, to send guidance command to the aircraft. The UNIFIS 3000 will log all configured data/parameters for later evaluation.

Easy and seamless operation with enhanced QA



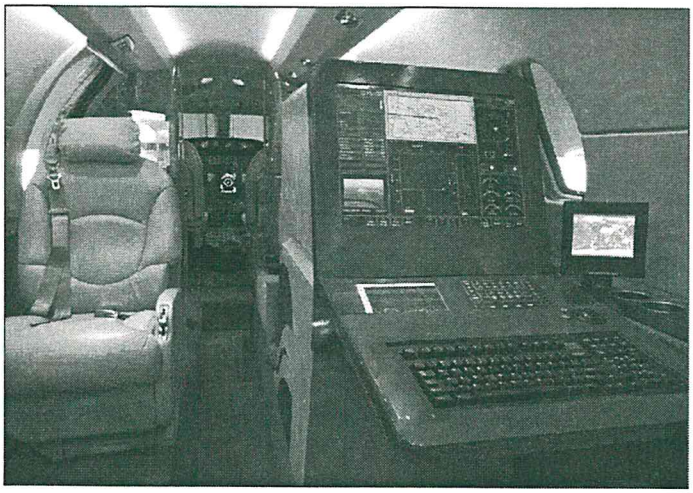
UNIFIS 3000 – Aircraft – Integration

Integration with the aircraft FMS or dedicated FI FMS is essential. Unfortunately the FMS is not standard and not delivered by the same manufacturer. Therefore the task of integration is cost demanding and the certification of each solution would be aircraft dependant. For a manufacturer it is therefore essential to have knowledge of the process.

The data from the FMS are read from the UNIFIS 3000. There is a lot of data needed from the FMS. Essential data is information about the aircrafts position in respect to the desired flight path defined by the procedure. Waypoints, status info, air data, RH, attitude etc.

Sending Flight Plan Data to the FMS is one requirement that the UNIFIS 3000 is specified to perform. The challenge is the certification of the aircraft after modification. So far the authorities would shift the aircraft over to limited category. Several projects are initiated to work through a solution. It is reasonable to believe that it will first be available for new avionics.

The UNIFIS 3000 can be integrated to one of the NAV or MLS channels as input to the Flight Control System. The certification would again mean that while under this particular inspection, the aircraft would change category.



The airborne systems are more and more integrated. The FI responsible needs to be confident that the systems uses the correct information. The integration towards the airborne systems like the FMS and subsystems and with the possibility to document by logging and comparing the data from this systems are essential for the evaluation of the IFP.

Design of a FI system is something that you leave to the people who have the knowledge and experience. As the integration towards new cockpit equipment becomes more necessary, it put an additional requirement on the organization selected to be responsible for this both technically and financially.

ILS FINAL REPORT

ENGM – GP 01R

Inspection category: ☑ Routine ☐ Commissioning ☐ Special ☐ Annual			Log nbr:	Ident: ONE	Facility: ENGM				
			Aircraft Reg:	Runway: 01 R	Frequency: 111,95 MHz			Date: 22 Mar. 2004	
Weather: CAVOK	Ground condition: CAVOK			Wind: 330/12				Equipment: UNIFIS 3000	
Observer in A/C: N/A		Theodolite: N/A				Pilot:			
NOMINAL VALUE: Glidepath angle				3,00 °	Half Sector		0,72 °	Within ICAO tolerance	
	Approach on LLZ course			TX-1 Level	TX-1 Approach	TX-2 Level	TX-2 Approach	Yes	No
MEASSURED VALUES	Glidepath angle			3,01 °	3,01 °	3,02 °	3,02 °	X	
	Width upper half sector (0-75 µA)			0,35 °	74 µA	0,35 °	74 µA	X	
	Width lower half sector (-75-0 µA)			0,36 °	76 µA	0,36 °	76 µA	X	
	Sector Width (-150-150)			1,43 °	1,43 °	1,46 °	1,46 °	X	
	Clearance below glidepath µA			> 180	> 180	> 180	> 180	X	
	Structure (Distance from threshold)		NM-4NM µA	1	± 1	1	± 1	X	
			4NM -1050m µA	1	± 1	1	± 1	X	
			1050m -Threshold µA	4	± 4	4	± 4	X	
	Modulation Balance 90 Hz / 150 Hz			40,0/40,0 %	40,0/40,0 %	40,0/40,0 %	40,0/40,0 %	X	
	Offset Approaches (window) TX:			*Fly L.	*Fly R.	*Fly L.	*Fly R.		
	Glidepath angle			°	°	°	°		
	Width upper half sector (0-75 µA)			°	°	°	°		
	Width lower half sector (-75-0 µA)			°	°	°	°		
	Clearance below glidepath µA			>	>	>	>		
Change in status of facility after flight inspection: ☐ Yes ☒ No				Restrictions still avalid (ref. AIP/NOTAM):				☒ Yes ☐ No	
Refernce: ☒ GPS ☐ PDOP					Time		Theodolitte		
Time fr next flight inspection					Limit				
Notes									
APPROVAL	Approved ☐ Cat I ☒ Cat II/III			Approved with restrictions		Not approved			
	☒ TX-1	☒ TX-2		☐ TX-1	☐ TX-2	☐ TX-1	☐ TX-2		
SIGNATURES	Flight Inspector			Place date		F/C			

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Evaluation and Reports

In addition to the manual evaluation of the FIP, which of course is very important, the UNIFIS 3000 presents to the FI a unique set of documented data.
The configuration of the system report printout is a post delivery task for the customer and the manufacturer but the essential information is:

- Accuracy of all CNS elements per Procedure defined waypoint. The SSR elements have to be post inserted into the system from the ground data.
- Example: DME accuracy, COM AGC, VOR accuracy, A/C pos v.s FMS pos. ACARS AGC,
- Accuracy of all CNS elements per Procedure defined legs. The SSR elements have to be post inserted (Asterix radar data) into the system from the ground data.
- The FMS and sub systems data and status. Typically the report would state if there was any non normal states. RH. (threshold) GPWS States (terrain clearance).

- FMS position per waypoint and leg versus FI system position.

- Sensors used in the Solution.

The ability to convert the conventional compared documented analysis also for the IFP inspections

UNIFIS 3000 – Checklist

- Create the new procedure (Manual, SEMI or fully integrated tools)

- Check the data in the USS.

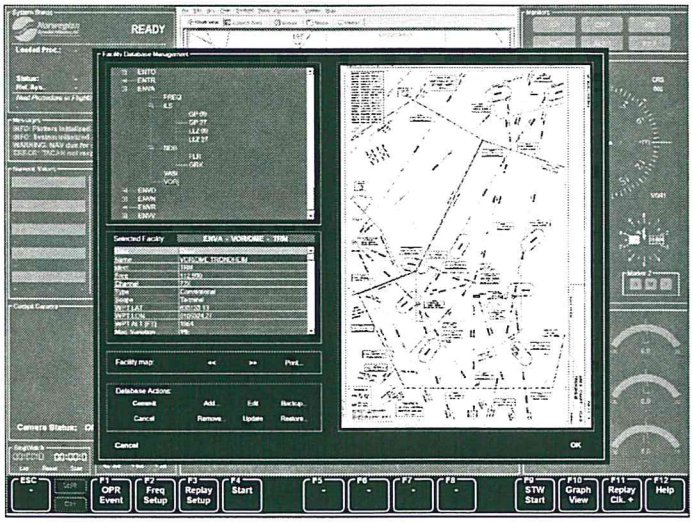
- Transfer the data from USS to the UNIFIS 3000 airborne unit.

- Load the procedure in the UNIFIS 3000

- Fly the procedure

- Evaluate manually and the report from the UNIFIS 3000.

- Approve the procedure



Essentials

The benefits of the UNIFIS 3000 is currently obvious for us, but of course, as it is presented by Norwegian Special Mission, the case is not totally objective.

The new UNIFIS 3000 enables the documentation for later analysis and questions. (QA)

It works with the new aircraft integrated systems (Technology)

Procedure Design Integration – (Innovative and Experienced Company)

The possibility to take the total responsibility for such a project (Financially strong)

LOOKING AHEAD – PLANS FOR 2005 – PDI

NSM have a Vision and Mission as a company, this again is transferred to our focus on the Navaids Flight Inspection Systems development, the Integration of Special Mission Equipment in aircraft and the offering of "Signal In Space" to customers.

Developing a tight integration with the Procedure Design Tools is essential. We have selected to work with the Italian Company IDS as the first company that we will "fully" integrate to their suite. What does this mean? That we will not only send data from the PDI to the aircraft for inspection, but received data for further analysis and use the experience data. That we will offer the products as a optional package with the FI system.

The work with the avionics and aircraft manufacturer is essential. The integration of the FMS and other systems requires unique knowledge of the complete system. NSM is working to enhance and possible standardize the future solutions.

CONCLUSION

This paper has presented some known challenges and problems in relation to the inspection of new or altered Procedures. It describes how NSM took this into the design of a new FI system called the UNIFIS 3000. The QA, the aircraft integration and the seamless integration from start to finish of the work is in focus. The integration with advanced PD systems like the systems delivered by IDS is an innovative path and it will essentially lead to easier work flow for the organization responsible. Further enhancement are airborne FI time saving by using collected data to simulate and extend the inspection interval further and by documentation.