



INVESTIGATING REPORT

on the fire occurred at the locomotive **DA 60-0945-0**
owned by SNTFM “CFR Marfa” SA, in the running of the train no. 83972,
on the current line Targusor Dobrogea-Nicolae Balcescu (km 31+000),
on the 23th of August 2010



Final EDITION

The 19th of January 2011

NOTICE

With reference to the accident occurred on the 23th of August 2010 in the running of the freight train no. 83972, by a fire to the locomotive DA 60-0945-0, in current line between hm. Targusor Dobrogea and CFR Nicolae Balcescu station (km 31+000), Romanian Railway Investigating Body carried out an investigation, according to the provisions of the Government Decision no. 117/2010. Through the investigation, the information on the respective accident was gathered and analyzed, the conditions were established and the causes determined.

Romanian Railway Investigating Body investigation did not aim to establish the guilty or the responsibility in this situation.

Romanian Railway Investigating Body considers necessary to take corrective measures in order to improve the railway safety and to prevent the accidents, so it included in the report a series of safety recommendations.

Bucharest, the 19th of January 2011

Approved by,
Dragos FLOROIU
Director

*I agree the compliance with the
legal provisions on the
investigation performance and
drawing up of this Investigation
Report, that I submit for approval.*

Chief Investigator
Sorin CONSTANTINESCU

This approval is part of the Report for the investigation of the accident occurred on the 23th of August 2010, in range of the Regional Branch CF Constanta, in the running of the train no. 83972 belonging to SNTFM „CFR Marfa” ,on the running section Tulcea - Medgidia, between the hm Targusor Dobrogea and the station CFR Nicolae Balcescu, at km 31+000, consisting in a fire at the locomotive DA 60- 0945-0.

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I. PREAMBLE

I.1. Introduction

The fire occurred on the 23th of August 2010 in the running of the freight train no. 83972 at the locomotive DA 60-0945-0 (structural subsystem – rail vehicle), is an accident according to art. 7, paragraph (1), letter e) from the ***Regulations for the investigation of the accidents and incidents, for the development and improvement of Romanian railway and subway safety***, approved by Government Decision no. 117/2010, hereinafter referred as “***Regulations***” in the investigation report.

Taking into account those above mentioned and according to the art. 19, paragraph (2) from the *Law no. 55/2006 on the railway safety*, corroborated with the art. 48, paragraph (1) of the ***Regulations***, an investigation commission was appointed by Romanian Railway Investigating Body.

Through the investigation, the information on the respective accident was gathered and analyzed, the conditions were established and the causes determined.

Romanian Railway Investigating Body investigation did not aim to establish the guilty or the responsibility in this situation.

I.2. Investigation process

Soon after the accident, Romanian Railway Investigating Body was notified about it verbally by the emergency Dispatcher 112 of the Romanian Railway Safety Authority and subsequently in written by CN CF “CFR” SA. After moving to the place of the accident, it observed:

- the locomotive DA 60-0945-0 which hauled the freight train no. 83972 from Tulcea to Medgidia, was detached from the train and stopped in current line (km 31+000) between hm. Targusor Dobrogea and the station CFR Nicolae Balcescu;
- the side covers of the diesel engine crankcase deformed outward in a specific explosion in the crankcase;
- the electrical wiring insulation and all the fuel in the engines box and the driving cabs of the locomotive, destroyed by burning;
- no damages at the lines and equipments in the accident.

In this accident the locomotive driver assistant died, being, according to the indices and to the witnesses statements, in the engines box while the incident occurrence.

At the accident place were present the representatives of:

- Inspectorate for Emergency Situations „DOBROGEA” – Firemen Point Medgidia ;
- Prosecutor’s Office of Constanta Court;
- Operative Department of Railway Transports Police;
- Romanian Railway Safety Authority;
- National Railway Company “CFR” SA;
- SNTFM “CFR Marfa” SA.
- Locomotives and Equipment Maintenance and Repair Trading Company "IRLU CFR" SA Bucharest

Through the **Decision** of the OIFR Director **no. 30** from the 24th of August 2010, according to the provisions of the art. 19, paragraph (2) of the *Law no. 55/2006 on the railway safety*, corroborated with the art. 48(1) of the **Regulations**, the investigation commission was appointed, consisting in:

BOBE Cristian	- head of IAFG-OIFR	- main investigator
DRĂGHICI Marin	- investigator-OIFR	- member
DOBRE Florin	- investigator-OIFR	- member
BĂTRÎNOIU Ștefan	- head of SC-Regional Branch Muntenia-Dobrogea	- member;

A. BRIEF PRESENTATION OF THE ACCIDENT

A.1. Brief presentation

On the 23th of August 2010, the freight train no. 83972 (belonging to the railway undertaking SNTFM “CFR Marfa” SA Bucharest), towed by the locomotive DA 60-0945-0 and by the pushing locomotive DA 60-1273-6, both belonging to the locomotive Depot Palas, after passing through hm. Targusor Dobrogea, running to station CFR Nicolae Balcescu, at km 31+000, around 6:30 p.m., an explosion occurred in the diesel engine crankcase of the locomotive DA 60-0945-0, followed by the expulsion of large amounts of gas and oil, its auto-ignition, occurring a fire in the engines box which spread to the driving cabs.

Before the occurrence of the explosion, driving being made from post no. 1 of the locomotive DA 60-0945-0, the locomotive driver noticed and announced the driver assistant about a diesel engine malfunction.

As stated by the locomotive driver, the driver assistant opened the door to the engines box and informed the driver that there was a release of smoke toward the workstation no. 2, going to the engines box for checks.

After the disclosure of the driver assistant on the existence of smoke, the driver asked the urgent braking of the train and the stop of the diesel engine.

During the train braking and diesel engine stop operations made by the driver, a violent explosion occurred in the crankcase, followed by the violent expulsion of large amounts of diesel vapors and oil that auto-ignited initiating the fire.

The driver assistant, according to the traces found subsequently, was caught in the violent expulsion of gas and oil that auto-ignited, in the area between the end of diesel engine and the work station no. 2.

After the explosion, the driver tried to enter the engines box from the work station no. 1, to save the driver assistant, but he didn't manage to do this because of the smoke, the high temperature, the gas that followed the explosion and the subsequent fire.

No access from outside to work station no. 2 was possible, in terms of ensuring from inside the window and the handle of the door lock, for which, unable to locate and extinguish the fire, the driver, together with the locomotive staff of DA 60-1273-6, called the emergency number 112, asking for the intervention of the Inspectorate for emergency Situations “DOBROGEA”, the fire being extinguished by the firemen belonging to the Fire Brigade Medgidia at 8:00 p.m. after about 90 minutes from the occurrence.

Until the arrival of the intervention teams belonging to ISU Dobrogea, they proceeded to detach the locomotive DA 60-0945-0 from the train and to re-park the wagons with the staff and the pushing locomotive DA 60-1273-6 in hm. Targusor Dobrogea.

The locomotive DA 60-0945-0 that towed the train 83972 belongs to SNTFM “CFR Marfa” SA and was driven / served by the driver / driver assistant.

The accident occurred in the area of km 31+000 on the current line between hm Targusor Dobrogea and the station CFR Nicoale Balcescu, placed in the embankment cross section, alignment and gradient ramp to 7 ‰ in the running direction.

Railway accident area is located on the circulation department Tulcea - Medgidia, belonging to CNCF CFR SA, CF Constanta Regional Branch.

A.2. Causes of the accident DA 60-0945-0 Targusor Dobrogea

A.2.1. Direct cause

The fire was caused by auto-ignition of diesel and oil vapors resulting from a technical failure caused by the emergence and rapid propagation of two cracks in the piston collar, started from the top in the vertical plane which contains axis bolt, followed by the weakening and the displacement of the piston collar no. 3, producing successively: cancellation of piston lubrication and cooling in the positioning of the segment and the phenomenon of dry friction, temperature rise above the normal range of operation, rapid erosion of compression and lubrication rings, melting layer peripheral side of the piston body and rapid accumulation of diesel vapors in the oil pan above the limit of drain technology.

Contributing factors

At the extent of fire contributed the expulsion of gas and around 600kg of hot oil from the engine to the entire engines box as consequence of the explosion in the crankcase with the deformation of side covers, leading to widespread the fire by burning it, the oil from the hydrostatic installation (aprox.30kg) and the combustible constructive elements (tubes and rubber gaskets, air filter elements, electrical wiring insulation, insulation and cushioning elements of the work stations).

A.2.2. Underlying causes

The inefficiency of the primary means of intervention, under violent fire propagation and failure in intervention by locomotive staff because of the gas and smoke, combined with the intervention of specialized staff from the Inspectorate for Emergency Situations at about 60 minutes from the notice.

A.2.3. Root causes

None.

A.3. Severity level of the accidents

According to the provisions of the **Regulations**, the event is categorized as accident, in accordance with the art. 7, paragraph (1), letter e.

A.4. Measures taken during the investigation

Immediately after the accident, the management of the rail undertaking SNTFM “CFR Marfa” SA ordered the reprocessing with all locomotive staff of the educational material of the document no. **E.1.6/26/2008** on how to intervene on route in case of abnormal noises at MD, explosion in the MD crankcase, smoke releases or fire beginning, which at point 1 provides: *“During the route is prohibited any intervention at the thermal or electric equipment of the locomotive, before the train / locomotive stop, braking and only after the locomotive driver has taken measures to stop the MD at the diesel locomotives and to disconnect the circuit breaker and put down the pantograph at the electric locomotives”*.

A.5. Safety recommendations

The safety recommendations aim to solve the next issues:

1. Including the work of checking the adhesion between the collar and the body of the piston, at every technical intervention, accidental repair, which involves the dismantling and the removal of the piston from the diesel engine in the process of maintenance carried out by the operators economically authorized as railway suppliers that have technical rail agreements for those type of intervention.
2. Analysis by rail operators who hold this type of locomotive (LDE 2100 CP) of the opportunity to complete the technical equipment of the locomotive with a facility to provide, until the intervention of specialized staff ISU, a fire mitigation, using the resource of about 1400 liters of water from the cooling system, or other equipment to enable effective intervention of locomotive staff in the presence of gas or smoke.
3. Initiation by the railway undertakings who hold this type of locomotive of a study to guide the development through the specialized services from the Romanian Railway Notified Body of a methodology for achieving the necessary checks to ensure the prevention of cracks in the piston collar in the composition of the diesel engine type 12 LDA 28.

The addressees of the safety recommendations are: Railway Notified Body, Romanian Railway Safety Authority, SNTFM "CFR Marfa" SA Bucharest and the other rail operators who hold this type of locomotive.

This investigation report will be sent to AFER – Services for development of standards, to the Romanian Railway Safety Authority, to SNTFM „CFR Marfa” SA, to SC CFR IRLU SA Bucharest and to the National Railway Company “CFR” SA.

B. INVESTIGATING REPORT

B.1. Description of the accident

On the 23th of August 2010 the freight train no. 83972, belonging to the railway undertaking SNTFM “CFR Marfa” SA Bucharest, was formed and sent from the station CFR Tulcea Marfuri in the train 83834 path, at 1:57 p.m., with the destination the station CFR Slatina, with exchange of towing system at CFR Medgidia station.

Towing of the train was provided by the locomotive DA 60-0945-0 (in head) and the locomotive DA 60-1273-6 (pushing), both being driven / served by the locomotive driver / driver assistant. The running from the formation to the accident occurrence had no technical or railway safety problems.

At around 6:30 p.m. after the train passed by hm. Targusor Dobrogea, in the area of km 31+000, while the train was driven from the work station no. 1 of the locomotive DA 60-0945-0, the driver noticed a decrease of the diesel engine power and the driver assistant, after opening the engines box

door, announced that there was a release of smoke in the turbocharger (towards the work station no. 2) and went to check.

After disclosure by the driver assistant about the presence of smoke, the driver of the locomotive DA 60-0945-0 took actions to stop the train by emergency braking and gave the order to stop the diesel engine, when the explosion occurred in the crankcase, catching the driver assistant, according to the traces and subsequent statements, in the engines box, in the area between the engine and the work station no. 2.

After the fire extinguishment, the driver assistant was found dead, under the driving board of the work station no. 2 of the locomotive, by the Intervention staff belonging to ISU “DOBROGEA”.

The immediate intervention of the locomotive driver and subsequently of the staff from the pushing locomotive to save the driver assistant, who was unconscious, was not possible due to the insurance from the inside of the sliding window and door handle to lock the access from the outside of unauthorized persons.

Intervention plan of the emergency rescue services

- under the fire expansion, the train CFR staff called, around 6:30 p.m., the emergency number 112, asking for the intervention of the Inspectorate for Emergency Situations and proceeded to detach from the train the locomotive DA 60-0945-0.

- after informing about the situation and receiving the acceptance of the IDM from the hm Targusor Dobrogea, the train was moved at 7:12 p.m. and was re-parked by the staff and the pushing locomotive DA 60-1273-6, with stop at 7:27 p.m..

- arrival on the scene of the ISU intervention teams happened, as reported the driver of the locomotive DA 60-0945-0, at around 7:30 p.m..

- the access into the engines box for intervention and saving the driver assistant was not possible because of the fire ignited by the diesel / oil vapors and maintained by the oil expelled by the explosion from the diesel engine tank and other combustible construction elements (lubricant oil, diesel from the additional tank, rubber elements and electric wiring insulation...) and only the intervention staff from the Inspectorate for Emergency Situations managed to break the sliding glass.

- after the intervention, the fire was extinguished by the staff belonging to Medgidia Firemen Brigade from ISU “DOBROGEA”, at 8:00 p.m..

- current line between hm. Targusor Dobrogea and the station CFR Nicolae Balcescu was reopened to rail traffic at 5:59 a.m. the 24th of August 2010, after the withdrawal of DA 60-0945-0 towed with DA 60-1273-6, in line 1 from hm. Targusor Dobrogea.

Locomotive condition on the scene after the fire extinguishment

- thermal influence of the fire on the locomotive box and frame (photo1);



Photo 1

Photo 2



- effects of the fire on the driving, indication and protection equipment from the work station no. 1 (photo2)

- effects of the fire on the driving, indication and protection equipment from the work station no.2 (photo3)



Photo. 3

After withdrawal of the locomotive in hm Targusor Dobrogea, but without any intervention or dismantling to determine the causes, in the engines box were found the following:

Photo. 4



Photo. 5



- pronounced deformation of side covers of the diesel engine crankcase specific to an internal explosion (photo.4;5);

Photo. 6

- thermal degradation of the electric equipment and of the combustible structural elements from the engines box and the block equipment of connecting, switching, monitoring and protection (photo. 6);



- there were not found obvious traces of short circuit or overheating at the electric circuits for control and supply of the electric traction engines;



Geographical location of the accident

To determine the causes of the fire, the locomotive was sent to Palas locomotive Depot, for the subassemblies disassembling and thorough checks.

On the 2nd of September 2010, with the approval of the involved parties, the aggregates and subassemblies were removed and the components of the electric diesel locomotive DA 60-0945-0 were checked.

B.2. The accident circumstances

B.2.1. Involved parties

- 2.1.1 Involved staff belongs to SNTFM “C.F.R. Marfa”- S.A, Constanta Branch, locomotive Depot Palas - Constanta.
- 2.1.2 The locomotive DA 60-0945-0 belongs to SNTFM “C.F.R. Marfa”- S.A. and it was repaired and maintained by the staff from SC “CFR – IRLU Bucharest” SA.
- 2.1.3 The railway infrastructure on which the accident occurred belongs to CN CF “CFR” SA and is maintained by its employees.
- 2.1.4 The installations of signaling, centralization and blocking (SCB) between hm Targusor Dobrogea and the station CFR Nicolae Balcescu are managed by CNCF “CFR” SA- CFR Constanta Regional Branch and maintained by its employees.
- 2.1.5 The installation of railway communications from hm Targusor Dobrogea and the station CFR Nicolae Balcescu is managed by CNCF “CFR” S.A. and maintained by the staff of SC TELECOMUNICATII CFR S.A.
- 2.1.7 The installation of railway communications on the involved locomotive belongs to SNTFM “CFR Marfa” SA and is maintained by the staff of Palas Locomotive Repair Department, belonging to SC “CFR – IRLU Bucharest” SA .

The investigation commission questioned the employees involved in the driving / service and maintenance of the involved locomotive and took statements from the IDM in charge from hm Targusor Dobrogea.

B.2.2. Forming and equipments of the train

The freight train no. 83972 (belonging to the rail undertaking SNTFM “CFR Marfa” SA Bucharest) consisted in 31 wagons (loaded with alumina) (1910 gt, length 476 meters) and it was towed with the locomotive DA 60-0945-0 and with the pushing locomotive DA 60-1273-6, both belonging to Palas locomotive Depot.

The safety and vigilance device (DSV), the installation of punctual check of speed and hitch-hiking (INDUSI) as well as the installation of speed indicating and recording (IVMS), in the locomotive DA 60-0945-0 equipment were affected by fire.

B.2.3. Railway equipments

The involved railway infrastructure, respectively the current line between hm. Targusor Dobrogea and the station CFR Nicolae Balcescu is managed by CNCF “CFR” SA- CFR Constanta Regional Branch and is maintained by its employees.

The current line (the area of km. 31+000) is in alignment, built with rail type 49, on concrete sleepers T17, placed in embankment cross section, alignment and gradient ramp to 7 ‰ in the running direction.

The lines of the running section Tulcea – Medgidia are not electrified and the trains running is by the system of agreement over the telephone (free way).

B.2.4. Means of communication

The communication between the locomotive driver and the movement inspectors was provided by the radiotelephone installation.

B.3. Accident consequences

B.3.1. Deaths and injuries

After the rail accident resulted the death of the driver assistant who has served the electric diesel locomotive DA 60-0945-0.

B.3.2. Material damages

- according to the estimate no. 358/ 24.11.2010, of CFR IRLU SA – Section Palas Constanta, amounted to 240 504,28 lei;
- at the lines – none;
- at the installations – none;
- at the environment – none;
- **Total 240 504,28 lei**

B.3.3. Consequences of the accident in the railway traffic

The current line, on the distance Targușor Dobrogea - Nicolae Balcescu was closed to railway traffic between 6:30 p.m. and 2:57 a.m. for the intervention of ISU staff and for the investigations on scene.

B.4. External circumstances

On the 23rd of August 2010, at the time of the railway accident, the current line between hm. Targusor Dobrogea and the station CFR Nicolae Balcescu was free and the visibility was good, clear sky, no wind and the air temperature was about 29 °C.

The visibility of the light signals was in accordance with the specific regulations in force.

B.5. Investigation course

B.5.1. The summary of the of the involved railway staff statements

B.5.1.1. The summary of the of the railway undertaking staff and infrastructure manager statements

The locomotive driver who drove the locomotive DA 60-0945-0, on the 23rd of August 2010, stated as follows:

- technical condition of the locomotive and was good and before leaving the Medgidia Depot the oil was completed in the diesel engine (at least 40-60 liters)
- on the 23rd of August 2010 at 12:30 he went to the IDM from the station Tulcea Marfuri for the checking before work;
- when taking the DA 945, he checks the quantities of water, diesel and oil, all of them being suitable, but he mentions that at the diesel engine the level of oil was 1 cm over the minimum due to the losses mentioned in the locomotive logbook, too;
- he coupled the locomotive to the train 83972 trailer on the distance Tulcea Marfuri - Medgidia as titular locomotive and the DA 1273 driven by the driver and served by the driver assistant was going to be pushing locomotive;
- at 1:57 p.m. is sent the train 83972 that was running in the conditions of the train 83834;
- the train ran without problems on the distance Cataloi – Cogevalac, the driver assistant made revisions in running, finding normal pressures to the MD oil;
- before the train arrives to the bridge Casian, the driver assistant makes a total revision in the engines box;
- when passing through Targusor Dobrogea, the train was defiled by the two switchmen and by the IDM, the last telling to the driver at around 6:22-6:23 p.m. that the train passed complete and signaled;
- after passing the counter light signal and attending a distance of about 200 meters, while the controller was in position 19-20, the locomotive driver notices that the diesel engine changed the specific in function noise, but without any change in speed or suspect beatings;
- he informed the driver assistant about his observations about the diesel engine functioning, but this one wasn't convinced about these problems. The driver assistant stood up from his chair, opened the door of the engines box, at that moment the driver put the handle controller to 0. After entering the engines box, the driver assistant went out immediately and informed the driver that there was smoke and he ran back in the engines box;
- he took immediate action to stop the train by switching the mechanical valve KD2 into fast braking position. After he took all the actions to stop the train, a very strong explosion releasing smoke occurred immediately;
- he tried to get in touch with the driver assistant shouting him and as he didn't answer, the driver enters the engines box with a fire extinguisher, but he only gets near the fan where he has to give up because of the very dense smoke;
- he came back to work station no. 1 where he takes another extinguisher and he tries again to enter, but he has to give up again.
- he descended from the locomotive and tried to go up to the opposite work station (station no. 2), but he doesn't manage because the access door was ensured from inside;
- while moving next to the locomotive he tried to announce the unique service 112, but he failed, so he called the driver of the pushing locomotive and asked him to try.

- he tried to break with rocks the glass of the access door of the work station no. 2, but he failed and he tried to break the front window but it broke only partially.
- after the firefighters arrived, they occur to extinguish the fire and then try to find the driver assistant;
- they failed to enter the work station 1 and then they broke the glass of the access door of the work station no. 2 where they found the driver assistant dead;
- the driver assistant entered the engines box by his own initiative and he didn't take any extinguisher;
- the locomotive was equipped with 8 fire extinguishers;
- the fire extinguishers were sealed, within the validity, two in each driving cabin and two on each end of the engines box;
- the locomotive had big losses of oil at cylinder head 12, losses mentioned in the logbook of the locomotive;
- ensuring the access door to the opposite station is a service obligation;

The locomotive driver who drove the pushing locomotive DA 60-1273-6, on the 23rd of August 2010, stated as follows:

- at CFR Tulcea Marfuri station, he coupled the locomotive to the train 83972 that it was going to tow on the distance Tulcea Marfuri – Medgidia as pushing locomotive;
- after the complete brake check, train documents traffic order receipt, at 1:56 p.m. the train 83972 is sent, with path in conditions of train 83834;
- train ran without problems to Cogea station, where he had to stop according to the traffic order;
- around 5:45 p.m. the continuity check was made to the train and it was sent from Cogea station at 5:50 p.m.;
- at km 31+500, the locomotive driver notices that there was a white smoke release at bottom of the locomotive in head of the train;
- he communicated through RTF station his observations to the driver of DA 945 and at the same time he found an emission of air and the pressure drop in the train general pipeline;
- he took action to switch the controller and the inverter drive of the DA 1273 to 0;
- he noticed that at DA 945 the smoke changed the color becoming darker
- he tried to get in touch by phone with the driver of DA 945, but he failed, at the same time the driver assistant went to tighten the handbrakes of the wagons;
- the driver assistant managed to get in touch with the driver of DA 945 and at his request he called 112;
- in the meantime he managed to get in touch with the driver of DA 945 who told him that he didn't know where was his assistant;
- he moved to DA 945, tried to enter the front work station but because of the smoke he failed;
- together with the driver of DA 945 tried to break with rocks the windows of the locomotive DA 945 at work station II to open then the access door to the driving cabin;
- seeing that he couldn't do anything, the driver of DA 945 released the locomotive from the train and he left with the locomotive DA 1273;
- he asked the permission of Targușor Dobrogea station to withdraw the train in the station, he got the permission around 7:10 p.m. and then the train was retired in Targușor Dobrogea station;
- the locomotive DA 945 was unraveled from the train and the train left to Targușor Dobrogea station before the arrival of the firemen;
- after the train parking and hand-braking, the locomotive DA 1273 is directed as help locomotive at 9:10 p.m. for DA 945 which it towed after the investigations to the station Targușor Dobrogea;
- he couldn't do anything to limit the fire to DA 945.

The driver assistant who served the pushing locomotive DA 60-1273-6 and the train no. 83972, on the 23rd of August 2010, stated as follows:

- after coupling the towing locomotives, at 1:56 p.m. the train 83972 is sent from the station Tulcea Marfuri to the station Cogevalac where the train is stopped to cross with the train 8653;
- after the train left the station Targusor Dobrogea, the driver of the locomotive DA 1273 announce that smoke could be seen on the bottom of the locomotive DA 945 that was towing the train, announcing this also to the driver of DA 945, moment in which the train was braked by sudden air pressure drop in the general pipeline;
- he noticed that at DA 945 the smoke changed color becoming darker;
- he went to tighten the handbrakes of the wagons;
- he remained to survey the locomotive DA 1273 while the driver went to the locomotive DA 945;
- at 6:30 p.m. he managed to call 112;
- when the locomotive driver came back it was asked the permission of the station Targusor Dobrogea to retire the train in station;
- during the events he was called twice by the firemen to guide them how to reach the scene;
- the train was sent from the current line before the firemen arrived.

Head of IRLU Palas department, regarding the technical condition of the locomotive DA 60-0945-0, stated as follows:

- the locomotive DA 945 entered the Palas Depot park in the 8th of January 2010 after a repair RG type, without technical modifications from the standard construction, excepting the metacons from the locomotive box and the diesel engine – generator;
- at the locomotive were made 2 overhauls type RT, without notifications of failure within the validity;
- the diesel engine didn't prove a big oil consumption, nor total dilution or big losses of water and diesel;
- a significant oil loss proved on the 9th of July 2010, because of the casing breakage of the centrifugal filter return pipe;
- at the diesel engine didn't occur any over-speed with onset of action of the protector, its seal being the one applied by the Department IRLU Craiova who performed the RG type repair;
- the diesel engine, prior to the accident, did not show: malfunction, abnormal MD noise or low pressure at the MD oil;
- the defect was not preceded by symptoms that can be found after interventions and revisions made by staff IRLU Palas.

Technical foreman from the department IRLU Palas, regarding the technical condition of the locomotive DA 60-0945-0, stated as follows:

- the locomotive DA 945 didn't have technical features to be observed in operation on the thermal;
- the overhauls made didn't intervened in the diesel engine by removing the side covers, bearings, cylinder heads;
- the defect of DA 945 wasn't found in 2010 to other locomotives;
- the locomotive DA 945 is within the warranty.

IDM on duty in hm. Targusor Dobrogea, on the 06th of June 2010, stated as follows:

- on the 23th of August 2010, at 4:50 p.m. was sent the provision RC no. 12 regarding the running of the additional train 83972;
- at 5:46 p.m. was asked free way for the train 83972. At 5:49 p.m. the train left Cogevalac, asked free way to the station Nicolae Balcescu, checked the direct line 2, gave the passing

command to the switching points and communicated through RTF station to the locomotive drivers the signals position.

- the train passed by hm Targusor Dobrogea at 6:22 p.m.;
- at the train parade he didn't notice anything special;
- after about 5 minutes he was announced by the RC operator to ask the driver of the train 83972 if he could get to the station Medgidia before the train 8654, if not he was going to be stopped in Nicolae Balcescu station;
- he asked the driver through the RTF station and until receiving the answer he was announced by a passenger who was on the station platform that there was smoke at the locomotive;
- going out to the platform he noticed that the train was stopped in current line and at the locomotive was a strong smoke;
- he called through RTF station the driver, but he didn't receive any answer;
- he announced the RC operator and the head of the station about the fire occurred at the locomotive of the train 83972.

B.5.2. Safety management system

In order to fulfill their tasks and responsibilities the infrastructure manager CNCF "CFR" SA and the rail operator SNTFM "CFR MARFA" SA created and implemented their own safety management system, ensuring the control of the performed activity risks.

In terms of emergency situations, the operating staff with specialization – traction was trained and tested in the following norms:

- Ord. MTTc 12/1980 – specific traction chapters;
- OMLPTL 1992/2002;
- Ord. 17 RLh/1/1988;
- Ord. 310/4/d/1114/1994;
- Provision DG SNTFM "CFR Marfa" SA no. 6/2007.

B.5.3. Norms and regulations. Sources and references for the investigation

In the investigation of the railway accident one took into account:

- minutes concluded by the commission on spot with reference to the condition of the rolling stock, lines and equipments;
- photos taken soon after the railway accident by the members of the investigation commission;
- minutes concluded by the commission and photographs taken during the dismantling and technical checks on status of the diesel engine to establish the causes of the accident;
- statements of the teams from the locomotives hauling the train and the IDM on duty from hm Targusor Dobrogea;
- minutes concluded by the investigation commission after the accident;
- documents on the locomotive maintenance and repair, provided by the persons in charge with its maintenance;
- inspection and interpretation of the technical condition of the elements involved in the accident;
- questioning of the staff in charge with the operation of the involved rolling stock;
- documents of release of the train.

B.5.4. Work of the rolling stock

B.5.4.1. Data found on the electric diesel locomotive DA 60-0945-0:

B.5.4.1.1. Data resulted from the checks carried out on the 2nd of September 2010, at Palas locomotive depot, by the investigation commission and repair staff of SC CFR IRLU – Craiova department and recorded in the minutes (piece of the investigation file) and photos (made by the investigation commission)

Following the checking of the investigation commission at the locomotive, one found out:

The condition of the electrical circuits and the equipment of connection, switching, monitoring and protection

The insulation of the power and command wiring completely burned, covers and fuel supports of the contactors, relays, switches, vigilance installations, INDUSI and speedometers with major thermal degradation.

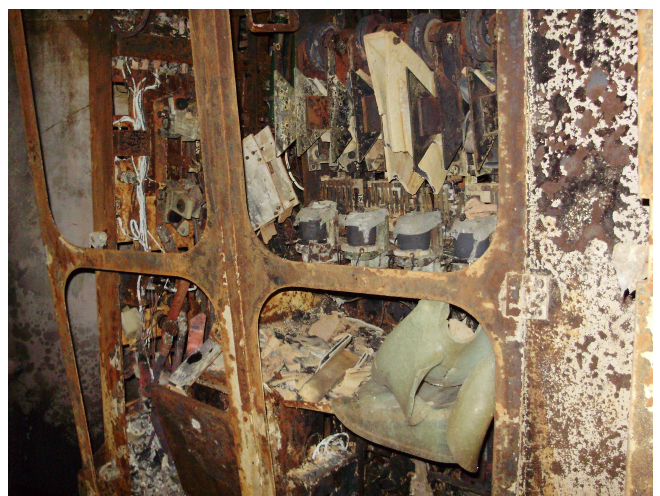
Thorough detailed checks made with the corresponding dismantling of the covers and check of the traction engines and of the main generator, there were not found traces of fire initiating flames or short circuits. In conditions of such degradation, from the electric diesel locomotive DA 60-0945-0, it wasn't possible to make discharges and interpretations of the equipment installations, (IVMS, ICL).

Photo. 7



Cable channel engines box (photo. 7)

Photo. 8



Block devices – MT line contactors (photo.8)



Photo. 9

Control panel – driving station no. 1 (photo. 9)

Condition of the running machines and of the brake pads

There were no traces of thermal influence on the pads, tires, suspension, bogies and wheelhouse due to the fire.

Photo. 10

Fuel tanks condition

- the afferent fuel lines were intact, thermal affected, without traces of recent intervention;
- the main fuel tank wasn't deformed by the overpressure created by the oil heating, with only slight traces thermal influence (photo. 10);
- the hydrostatic installation tank empty with the flexible connections type Argus burned;



Condition of the main aggregates

- the visiting covers were removed and there were checked the compressor, the electric forced ventilation engines, the transfer pump, the main generator and the traction engines, without finding generating fire causes;

Condition of the components and subassemblies of the diesel engine of DA 60-0945-0

- after removing the side covers of the crankcase and facing the engine mechanisms, one proceeded to rotate the engine manually without finding its locking, which implied that there were not landing or rod bearing melt (photo 11 and 12), further confirmed after dismantling;

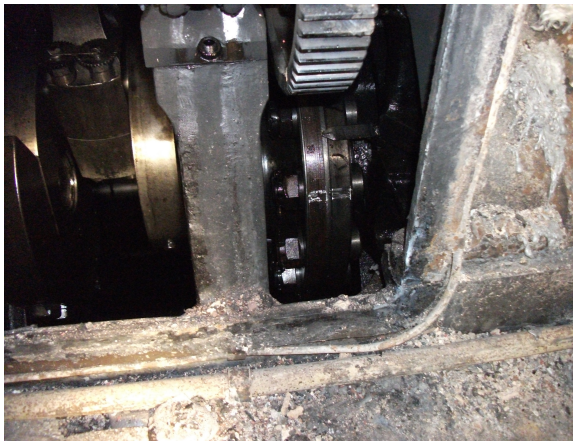


Photo. 11

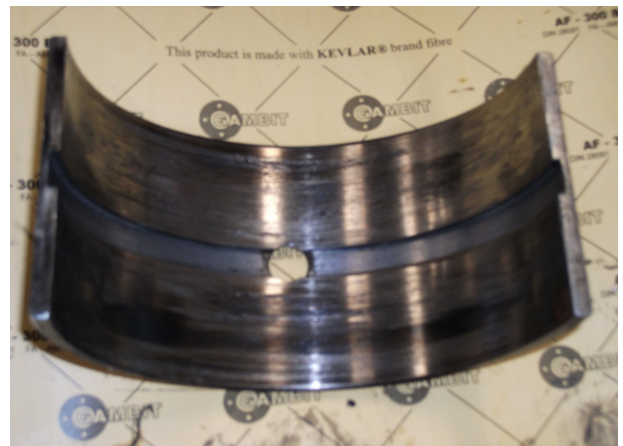


Photo. 12

- at the plunger no.3 (series 48309/1981) were found the following defects (photo.13):
 - two cracks at the top, diametrically opposed, in the same plane with the axis of the piston pin;



Photo. 13

- the piston collar moved about 10 mm from the piston body, without affecting valves workspace, with strong traces of friction and material melting;

at the other 11 pistons of the diesel engine were not found defects leading to malfunction of the diesel engine (photo. 14)



Photo. 15



Photo. 14

- transfer of material (aluminum) from the body of the piston its deposition on the cylinder of the piston (photo. 15);

Oil samples were taken from the engine tank where there was an amount of about 200 kg to the 800 km normal capacity, the difference being expelled in the engines box and subsequently maintained the fire.

From the analysis performed, according to the test report no. 879/02.09.2010, his test showed a viscosity of 8.79 gr. E, the flash point couldn't be established because of the presence of water from the fire extinguishment.

At the analysis of the oil sample taken from the combined filter, according to the test report no. 881/02.09.2010, it resulted a viscosity of 8.44 gr. E, with flash point at 201gr.C, without traces of water, which means that the infestation has not occurred before stopping the diesel engine.

B.5.4.1.2. Data resulted from the analysis of the documents asked from the railway undertaking

- the locomotive was put into service after the building, new, on the 6th of June 1974;
- the last repair type RG (general repair) was made at IRLU Craiova Department, according to the minutes no. 849/21.12.2009, being taken and put into service on the 4th of January 2010, with a warranty term of 9 months;
- the defected piston no. 3 was made by UCM Resita in 1981 having the series 48309 and it was tested and installed on the diesel engine on the 31st of July 2009 at the RG type repair;
- the last overhaul type "RT" was made on the 5th of July 2010 at Palas Locomotive Repair Department belonging to SC CFR IRLU Bucharest;

B.6. Analysis and conclusions

B.6.1. Analysis of the fire occurrence

The fire occurred in conditions of self-ignition of the diesel vapors and the engine oil from the diesel engine crankcase, followed by explosion, being maintained by burning of the oil expelled from the tank in the engines box and then burning of the other combustible construction elements (sleeves, tubes and rubber gaskets, hydrostatic installation oil, electrical wiring insulation, diesel left in the additional tank after burning of the sealing gaskets, dirt soaked with oil tailings, trim elements...).

The production of combustible vapors and gas was because of the cracks (photo. 16) of the collar piston no. 3, occurring its dislocation, which by moving with about 10 mm obstructed the internal oil channels that provide the lubrication and especially the cooling of the segments area.

Under these conditions, the operation of the piston without lubrication and cooling led to an increase of temperatures above the operating values (350-400°C), fast erosion of the segments, loss of compression so that the amount of diesel injected at temperatures over 700°C produced its aerating and of the oil from the piston body with their accumulation in the crankcase and causing the explosion through the explosion flaps, this being the first “smoke release” aspired by the turbocharger and the forced ventilation of the traction engines and that was noticed by the locomotive staff in the engines box to work station no. 2, respectively under the locomotive as it was noticed by the pushing locomotive staff.



Photo. 16

Until the diesel engine stop, the temperature increasing produced the melting of the layer contact surface of the piston and its dissemination on the coating accompanied by rapid increasing of the gas amount followed by auto-ignition, explosion in the crankcase and expulsion in the engine box of the oil from the tank.

By dismantling and removing the piston, were found traces of molten metal and thermal influence zones (blue color) on the piston generator, which confirms the overcome of the aluminum melting temperature (660°C).

B.7. The causes of the accident A 60-0945-0 Targusor Dobrogea

B.7.1. Direct cause

The fire was caused by the auto-ignition of the diesel and oil vapors resulting from a technical failure caused by the emergence and rapid propagation of two cracks at the piston collar, started from the top in vertical plane which contains the bolt axis, followed by the detachment and moving of the piston collar no. 3, producing successively: cancellation of piston lubrication and cooling in the positioning of the segments and the phenomenon of dry friction, temperature increasing above the normal limits, rapid erosion of the compression and lubrication elements, melting of the peripheral layer side of the piston body and rapid accumulation of the diesel vapors in the oil tank over the technological limit of evacuation.

Contributing factors

At the extent of the fire contributed the expulsion of gas and around 600 kg of hot oil from the engine to the entire engines box as consequence of the explosion from the engine crankcase with the deformation of the side covers, leading to the fire widespread by burning it, the oil from the hydrostatic installation (around 30 kg) and the combustible construction elements (tubes and rubber

gaskets, air filter elements, electrical wiring insulation, insulation and cushioning elements of the driving stations).

B.7.2. Underlying causes

The inefficiency of the primary intervention means, under violent fire propagation and drive failure by the locomotive staff because of the gas and smoke, combined with the intervention of specialized staff from the Inspectorate for Emergency Situations, at about 60 minutes from the notice.

B.7.3. Root causes

None.

B.3. Severity level of the accidents

According to the provisions of the **Regulations**, the event is categorized as accident, in accordance with the art. 7, paragraph (1), letter e.

B.4. Measures taken during the investigation

Immediately after the accident, the management of the rail undertaking SNTFM "CFR Marfa" SA ordered the reprocessing with all locomotive staff of the educational material of the document no. **E.1.6/26/2008** on how to intervene on route in case of abnormal noises at MD, explosion in the MD crankcase, smoke releases or fire beginning, which at point 1 provides: *"During the route is prohibited any intervention at the thermal or electric equipment of the locomotive, before the train / locomotive stop, braking and only after the locomotive driver has taken measures to stop the MD at the diesel locomotives and to disconnect the circuit breaker and put down the pantograph at the electric locomotives"*.

C. Safety recommendations

The safety recommendations aim to solve the next issues:

1. Including the work of checking the combination between the collar and the body of the piston, at each technical intervention, accidental repair, which involves the dismantling and removal of the piston from the diesel engine in the process of maintenance carried out by the economical operators, authorized as rail suppliers and who have technical rail agreements for the respective types of intervention.
2. Analysis by rail operators who hold this type of locomotive (LDE 2100 HP) the opportunity to complete the technical equipment of the locomotive with a facility to ensure, until the intervention of the specialized staff ISU, a fire mitigation, using the resource of about 1400 liters of water from the cooling system or other equipment to enable effective intervention to locomotive staff in the presence of gas or smoke.
3. Initiation by the railway undertakings who hold this type of locomotive of a study to guide the development of the specialized services of the Romanian Railway Notified Body of a methodology for achieving the necessary checks to ensure the prevention of cracks at the piston collar of the diesel engine model 12 LDA 28 composition.

The addressees of the safety recommendations are Romanian Railway Notified Body, Romanian Railway Safety Authority, SNTFM "CFR Marfa" SA Bucharest and other rail operators who hold this type of locomotive.

This investigation report will be sent to AFER – Services for development of standards, to Romanian Railway Safety Authority, to SNTFM "CFR Marfa" SA Bucharest, to SC CFR IRLU SA Bucharest and to National Railway Company “CFR” SA.

Members of the investigation commission:

- Cristian BOBE - main investigator -----
- Marin DRĂGHICI – investigator -----
- Florin DOBRE – investigator -----
- Ștefan BĂTRÎNOIU – head of “CFR Marfa” Constanta Branch -----