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**INCREASED COSTS RESULTING FROM TRACK BLOCKING IN  
RAILWAY TRAFFIC**

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**Preface**

Most of track blocking works in railway traffic intervening in railway infrastructure cannot be done during interludes between trains. Due to this fact, almost each track blocking causes reduction of serviceability of the railroad and railway traffic. To realize such works, it is necessary to accept traffic measures, which will allow to stop the railway traffic on the railroad during the track blocking works.

Regarding to the character of the railroad, at which the track blocking works are being done, the following cases may occur:

- the railway traffic is stopped during the track blocking works – this case occurs mostly with track blocking of tracks or headers of railway stations on single-track railway, passenger trains are replaced by bus service or diverted on another suitable railway track, freightliners are led in time out of the track blocking works or (regarding to the length of the track blocking work) also diverted on another railway track rounding the excluded part of the railway,
- during the track blocking works, the railway traffic is partly limited - this case occurs mostly with track blocking of tracks on multi-track railways or track blocking of station tracks, in these cases the railway traffic at points touched by track blocking is kept, even at the cost of train delays or other traffic restraint. As long as

the traffic-carrying capacity of the remaining non-blocked part of the railway infrastructure (nearby track line or non-blocked part of station tracks) doesn't allow to lead all trains regularly led in that part of the line, it's necessary for some trains to take some traffic or transport measures similar to those, which are taken during track blocking with complete interruption of railway traffic.

During the track blocking activities the contending economical interests of the following three subjects are colliding (various companies or organizational subdivisions of one railway corporation):

- railway owner,
- railway operator,
- railway transport operator.

### Railway owner's costs

The railway owner has the law duty to provide serviceability, advancement and modernization of the railway. Mostly he cares that the repairing and other works, leading to the purpose mentioned above, were done during time period which is, regarding to the technical and personal costs (his or the hired maker's), the best for such works, it is - as long as possible during daytime of working days within the ordinary workshift, no during Saturdays and Sundays, nighttime or lengthened workshifts requiring overtime work of employees.

The railway owner's or line operator's costs are regarding to selected term of track blocking almost changeless because maintaining the work during the track blocking depends on used technology, that's why this report doesn't concern about them. However, if the length of the track blocking conforms the railway operator's and railway traffic's requirements, the railway owner could have some of the following increased costs:

- costs resulting from work of employees above the ordinary working hours – at night, on extra-working days or overtime. This increased costs are rising either as direct labour costs or as increased costs invoiced by foreign makers for work of their employees done during the track blocking. According to valid Code of remuneration of the employees of ČD it is at present 12 Crowns per hour at nighttime from 10.00 p.m. till 6.00 a.m., 15 Crowns per hour for work during Saturdays and Sundays a 33 % of average hour earnings for overtime work. According to growth of other personal costs it is necessary to increase these sums by 100%. As long as the track blocking works will be done (except the employees of Czech railways) by employees of foreign subject (maker), the growth of personal costs of these employees will be similar according to wage-conditions of the appropriate company. Though, in the agreement with the maker, it is necessary

to assure, that the amount to be paid for extra-work or night-work will be adequate to this growth.

- costs of lighting the workplace at night – these costs must be enumerated for each track blocking separately. Sometimes the track blocking place is well lit by static light sources. In all other cases, it is necessary to use light sources powered by electricity from power distribution or an gas-engine aggregate (this device belongs to standard equipment of diesel-trains for traction mains maintaining). In case of track blocking at electrified track, lighting can be provided directly by employees making the outage of traction mains (power-drain is the only cost), in other cases, it is furthermore necessary to add the costs of transport of the lighting device and plant of the service staff.

### Railway operator's costs

The railway operator allows the railway traffic operators to maintain continuous and safe traffic and maintains the traffic control on the traffic way itself. He is interested in the smallest restriction of serviceability of the railway during the track blocking (so that the track blocking was made in time period with the smallest traffic frequency). His goal must be to allow the railway traffic operators to make their business with the smallest restrictions.

Railway operator's costs – these costs don't present a significant amount in total track blocking costs. These costs are:

- profit loss from external railway traffic operators for traffic control on traffic way, as long as the renunciation of trains without recompensation occurs during the track blocking,
- extra traffic-service costs, as long as the track blocking is made at night, when no regular trains go by and is necessary to call up the traffic employees to maintain the service of rail vehicles used for track blocking.

### Railway traffic operator's costs

Railway traffic operator runs his own passenger or freight traffic and thereby he provides service to passengers and transporters as his customers. He has similar economical interest as the railway operator, it is - so that the track blocking was made with the smallest affect of offer and quality of his traffic services in order to minimize the profit lost and at the same time the costs resulting from transport and traffic precautions allowing to make the track blocking (alternate traffic, diversion of trains etc.).

Railway traffic operator's costs are the most important amount in total track blocking costs. These costs are the following:

- alternate passenger traffic costs – these are the alternate bus traffic costs, which are charged by transporters providing these services. The bus passage price per 1 km is presently moving between 22 - 30 Crowns and depends on concrete transporter and used vehicle mode. Bus journeys between garage and place of engagement and empty-bus journeys between railway stations must be also counted into kilometer count of the vehicle. Usually a couple of buses are engaged to one train, sometimes 10 or 15 vehicles, which increases these costs of course. Transporters with lower price per km, usually charge also tariffs for the idle time of the vehicles amounting to 100 - 150 Crowns per hour of waiting. Alternative belongings and express parcels freight transport costs can be evaluated in the similar way, if it is necessary to provide it during the,
- passenger traffic delay costs – these costs include the idle time of driving and connecting vehicles, necessary overtime work of train employees and other costs of delay conveyance on trains unaffected by track blocking. Due to passenger train delays during the track blocking a related passenger discomfort during crossing passages between trains and alternate traffic vehicles, the reduction in demand for railway traffic and decrease of sales occurs(not only through the track blocking, but subsequently also due to the „negative advertisement“, which is the result of incidence of low quality services on passengers during the track blocking). Exact evaluation of this amount is problematic, because the loss of sales due to the reduction in demand for lower quality traffic services, can be not only during the track blocking, but can also occur in the long term. The passenger traffic delay costs calculated by Czech railways are shown in the table tab. 1:

<b>Train type</b>	<b>Crowns/min at peak time</b> (5.00 - 8.00 a 12.00 - 17.00 hod on workdays)	<b>Crowns/min out of peak time</b> (at another time)
Passenger	200,-	100,-
Speedy, fast	400,-	200,-
Eurocity, Intercity, expres	600,-	300,-

**Tab. 1** Passenger traffic delay costs due to the track blocking

- extraordinary train drives costs due to track blocking – these are especially costs of drives of diverted trains (passenger or freight) and extraordinary assembly-train drives, as long as they are necessary due to turning round of trains during the track blocking. Practically the amount of costs of 1 km of diverted drive are determined and applied only on leght difference between diverted and ordinary track. The same amounts can be used for evaluation of extraordinary drives of driving vehicles, which occur due to the track blocking (e.g. during drives of empty passenger trains or drives of driving vehicles extraordinary services caused by

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track blocking). These costs (including costs of usage of driving or drawn vehicles, power drain, train maintenance and usage of track by extraordinary trains) are calculated by Czech railways to evaluate the track blocking costs in the following amounts:

<b>traction of the driving vehicle</b>	<b>Crowns/km in passenger traffic</b>	<b>Crowns/km in freight traffic</b>
10 – electrical, direct-current	55,40	79,60
20 - electrical, alternating-current	45,20	74,00
30 – electrical, dual	58,00	76,40
40 – electrical waggon, direct-current	57,10	-
50 - electrical waggon, alternating-current	56,90	-
70 – gas	58,30	137,80
80 – gas waggons	44,60	-

**Tab. 2** Extraordinary train drives costs due to the track blocking

Costs of extraordinary usage of driving vehicles at railway stations and their idle time due to the track blocking, as long as it is necessary to use alternate driving vehicles instead of them, aren't separately calculated. From case to case this calculations could be provided by appropriate engine house.

- idle time costs of freight trains due to the track blocking – in terms of increased costs for the service of driving vehicles, it's possible to think amount of 1600 Crowns per hour of idle time of trains without traffic staff and 2000 Crowns per hour of idle time of trains with traffic staff,
- delay and accelerating period costs due to slow driving while tracks are semifinished during each track blocking – this amount includes increased power drain during accelerating period of trains after finishing slow drive and costs of related delays of passenger trains - these costs can be evaluated by amounts similar to those described in table 1,
- increased personal costs in necessity of employment of other employees of the railway traffic operator e.g. for displacement during turning of trains, coordination of buses of alternate traffic etc. - these costs correspond with real personal costs of employing engaged employees.

Although it is paradoxical, track blocking allows the railway traffic operator some decrease of costs, especially economies for spared passenger and freight train drives, which were renounced due to the track blocking. For economical evaluation of these

spares are used the same amounts of costs, which are described in table 2. However, in most cases are these spares multiply surpassed by costs of alternate bus traffic, assembled train drives and other related traffic measures.

Regarding to the fact, that in most track blockings on railways in Czech Republic are Czech railways Inc. at the same time the track manager (which is charged with the railway owner – the state represented by Management of railway traffic Ltd.), railway operator and railway traffic operator, activities mentioned above blend together in one subject and are represented by the following organizational units of Czech railways:

- track manager is the Division of traffic route, s.p. and it's executive elements,
- railway operator and railway traffic operator is the Service operating division, s.p. and it's operating units, whereas these two activities vary in terms of another organizational structure of top and middle structures of management of this division.

In case of track blocking, which are managed on all three sides by Czech railways as simple railway company, as well as during track blocking with incidence on other railway operators or railway traffic operators, it is necessary to co-ordinate the track blocking activity so that it's whole negative impact on railway traffic economy was the least. This impact cannot be entirely prevented from many objective reasons, though compared to present situation, it is possible to effectively minimize it. Strict economical viewpoint is necessary not only for large track blockings made for investments during modernization of railway infrastructure, but primarily during common track blockings made for maintainance and repairs of equipment of the track, which have especially at single-track railways heavy reserves in their efficiency. From all of the technically possible variants of the track blocking, the one which causes the smallest costs increment to the railway transporter, must be chosen.

Although the economy of the Service operating division and Division of traffic route is financially and accountingly separated within Czech railways, a great heed should be set on minimal economical loss due to the track blocking. Standpoint of the Service operating division to concrete track blocking should always be the primary, because the Service operating division is basically the executive section of the company, actively participating on basic commercial activities of Czech railways (providing services for customers in passenger traffic as well as in freight traffic). Division of traffic route is the service organization, which itself doesn't provide services to customers, but due to it's attention to technical infrastructure, it allows the Service operating division to provide these services. Therefore it is necessary for each track blocking required by Division of traffic route to look for such a form of it's implementation, which means the smallest growth of costs of the Service operating division. Only if the growth of costs of Division of traffic route would distinctively exceed the expected savings of Service operating division, performing the track blocking at the most profitable time for the Division of traffic route is economically competent and can be permitted.

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The purpose of evaluation of these costs is to financially stimulate the constructors of railway constructions in the section of preparation, planning and realization of the track blockings itself so that the impacts of track blockings would bring minimal increased costs of maintaining the planned operational activities and minimizations of the length of the track blockings to the Service operating division of Czech railways.

### **Practical determination of additional track blocking costs at the 2nd tranzit corridor between Česká Třebová and Přerov (section to 18.7.2003)**

In conditions of solution of engaged study, the determination of additional track blocking costs is determined, namely increased costs resulting from maintaining diverted drives of freight trains, payments of delayed passenger trains and determination of basic amount of increased costs evoked by building activities if the investor.

#### **Determination of basic amount of additional costs per hour of track blocking activities at the track between Česká Třebová and Přerov**

Basic amount of additional costs, which is payed by investor as footage of additional costs joined with providing the service during the track blocking activities, should count with increased costs of Service operating division resulting from:

- loss of prestige of Czech railways Inc., reduced quality od Czech railways's Ltd. Services during realized track blockings,
- advance workings, including administrative duties of Czech railways Ltd. (track blocking orders, monthly and weekly plans, applications to Railway office etc.),
- slow drives costs incurred during track blocking,
- transport penalties costs, in case of break of delivery dates and connections from the side of Czech railways Ltd.,
- freight trains delays costs,
- adequate profit.

Other additional costs, which aren't included in the basic amount, will be determined separately.

In terms of realization of track blocking activities for modernization of the track between Česká Třebová and Přerov in the section of 18.7.2003, the investor requires the following track blockings in order to make building operations:

- section Olomouc - Štěpánov – 2nd track,
- section Střeň - Červenka - 2nd track,
- railway station Střeň – even-numbered group of tracks,

- section Most - Lupěné - 2nd track,
- section Hoštejn - Tatenice - 2nd track,
- railway station Třebovice v Čechách – uneven group of tracks (departure track to Mladějov between 10 a/b-T2) .

The valuation of basic amount of additional track blockings costs goes from the importance of the track and length of the traffic interrupt (according to prescript of Czech railways D7/2). In case of tracks being viewed in the section Česká Třebová – Přerov, first main nationwide traction without complete traffic interrupt is concerned, it is - by exclusion of track parts of one track group and one of the tracks. Realized track blockings enable full service of passenger and freight traffic. Exclusion of station track groups and rails inflicts deterioration of operational conditions and evocates losses (issued from additional costs of operational, administrative and preparative activities) mentioned above.

In terms of stated ways of partial traffic interrupt on 19,6 km of total length of 180,4 km of track Česká Třebová – Přerov and the importance of evaluated tracks, basic amount of c. 20 000 Crowns per hours was stated, in which logically the greatest amount of additional costs falls on slow drives losses caused by partial track interrupt..

Whole daily amount of basic additional costs is (on condition of 24 hour work activity during track blockings on track Česká Třebová – Přerov):

$$20\ 000 \times 24 = 480\ 000 \text{ Crowns per day}$$

Stated guess of basic amount considers the maximal anticipated amount. In the fact it is possible to count with lower additional costs, because the losses mentioned could be decreased by e.g. possibility of shortening the train delays at track parts and technical stations on the track and with non-usage of all commonly offered freight train railways.

### **Determination of additional costs of diverted freight train drives during track blocking activities**

Train diversion costs include costs of traffic of driving vehicles, wagons and train escorts. Additional costs of realized diversions can be determined as difference between costs rated on the track by GVD and diverted track costs. If the diverted track costs are greater, they are considered as additional costs resulting from diverted train drives.

Average costs per train km of direct-current and diesel-electric traction for freight trains are used for determination of costs. In this solution part of the study, passenger trains aren't diverted. Train costs per km were determined according to table **tab. 3**.



Determination of operational losses caused by diverted freight trains goes from stated number of diverted trains between Česká Třebová and Přerov according to constructed track blocking GVD.

Suggested track blocking flow sheet allows the maintainance of treight traffic without diversions. Due to this fact, the diverted trains losses weren't counted in the course of detemination of whole additional costs resulting from track blocking.

### **Determination of additional costs caused by passenger trains delay during track blocking activities**

During maintainance of railway constructions of the 2nd corridor, passenger train delays will occur in planned measure according to allowed track blockings. At the transporter's point of view, it is necessary to shorten these delays as short as possible, especially by higher-quality passenger trains (e.g. EC, IC) which can cause the loss of international traces according to international agreements. Furthermore express-, fast- and speed-trains are prior in domestic traffic and other passenger trains are important especially for transport of passengers to work and back. Train delays not only cause, due to the reasons mentioned above, the loss of transporter's image and efflux of customers to competition, but mostly losses of transport services as a result of these influences.

For the purpose of evaluation and charging of passenger train delays, delay payments per minute were determined (diferentially according to train types) by the transporter. During selection of railway constructions suppliers, those ones, which are best in coordination of railway construction with railway traffic process so that the expected transporter's pay-offs were at least touched and cut, are preferred.

The tariff scale mentioned above (*tab. 1*) was used for evaluation of expected train delays during construction of the 2nd. corridor according to worked technologies of track blockings in touched railway stations parts between stations. During planned track blocking, the A tariffs were generally used. As long as the time of regular train drive in track part touched by track blocking falls even partially into range from 5.00 a.m. till 8.00 a.m. or from 12.00 a.m. till 17.00 p.m., delays were evaluated according to B tariffs as it is practically applied by Czech railways Inc. Possible shortening of driving times in track-parts linked to track parts with planned track blockings and possible lengthening of track blockings caused by railway constructions suppliers, was not counted during evaluation.

The calculation of passenger train delay losses caused by planned track blockings during the construction of the 2nd. corridor on the date of 18.7.2003 goes from expected train arrival delays.

Arrival delay of all kinds of passenger trains, which was determined due to causes of particular track blocking phases, was elaborated id the following tables.

[1] Track - part	5.00 – 8.00 a 12.00 – 17.00			another time			
	Train type	Delayed trains count	Delay in minutes	Crowns	Delayed trains count	Delay in minutes	Crowns
Č.Třebová - Přerov	EC, IC, Ex	3	23,0	13 800	5	26,0	7 800
	R, Sp	7	66,5	26 600	14	93,5	18 700
	Os	12	114,5	22 900	7	68,5	6 850
Total B tariffs				63 300	Total A tariffs		33 350
<b>[2] Summary for direction Česká Třebová – Přerov</b>							<b>96 650</b>

**Tab. 3** Calculation of losses from train delays in direction of Česká Třebová - Přerov

Track - part	5.00 – 8.00 a 12.00 – 17.00			another time			
	Train type	Delayed trains count	Delay in minutes	Crowns	Delayed trains count	Delay in minutes	Crowns
Přerov - Č.Třebová	EC, IC, Ex	6	65,5	39 300	2	16,5	4 950
	R, Sp	8	75,5	30 200	10	91,0	18 200
	Os	8	79,0	15 800	9	52,5	5 250
Total B tariffs				85 300	Total A tariffs		28 400
<b>[3] Summary for direction Přerov – Česká Třebová</b>							<b>113 700</b>

**Tab. 4** Calculation of losses from train delays in direction of Přerov – Česká Třebová

Total losses from train delays caused by track blockings on the 2nd. corridor on the date of 18.7.2003 amount 210 350,00 Crowns. Due to the great potential losses determined, operational management staff must pay attention to maximal utilization of chance of shortening the driving times on other track-parts before the arrival station of EC, IC, SC, R and Sp trains.

Removal of heavy delays threat is very important in prevention of shortening of Czech railways Inc.'s pay-offs due to the loss of tracks according to international agreement, loss of image and efflux of customers to competition.

### **Summary of expected daily additional costs of track blocking activities on track parts of the 2nd. corridor (on the date of 18.7.2003 - Friday)**

Track blocking realization between Česká Třebová and Přerov evokes economical losses from the basic amount of additional costs, diverted freight train drives and passenger train delays.

Total daily economical losses from additional costs mentioned above evoked by track blocking realization will be determined as sum of partial additional costs, and that is:

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Track part Úsek Česká Třebová - Přerov

480 000 + 210 350 = 690 350 Crowns per day

Track blocking realization on the mentioned track-part of the 2nd. corridor evokes on the date of 18.7.2003 total economical losses, which relate to maintainance of operational activity of Service operating division Inc. in total amount of average costs per day:

Track part Česká Třebová - Přerov 690 350 Crowns per day

Both investor and supplier should be interested in covering of economical losses, which should motivate them for minimization of track blocking length.

*Lektoroval: Doc.Ing. Jan Eisler, CSc.*

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### Resumé

#### NÁZEV ČLÁNKU CHYBÍ

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Výluková činnost je nezbytnou podmínkou pro zajištění provozuschopnosti železničních tratí, neboť technologie prací při údržbě a opravách železniční infrastruktury si vynucuje přerušování a omezování železničního provozu při jejich provádění. Z ekonomického hlediska je však nutné provádět výluky takovým způsobem, aby jejich negativní dopady na vlakovou dopravu, a tím i hospodaření železničního podniku, byly minimalizovány. Nesmí být nadměrně omezena nabídka přepravních služeb a jejich kvalita, stejně tak by nemělo docházet k enormnímu nárůstu nákladů na zajištění náhradní přepravy a jiná provozní opatření.

### Summary

#### INCREASED COSTS RESULTING FROM TRACK BLOCKING IN RAILWAY TRAFFIC

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Track blocking is a necessary condition managing the correct function of railways, for the technology of preservational and repairing works of the railway infrastructure requires interrupting and restricting of transport activities while these works are carried out. For economical reasons is

necessary to arrange blockings so that their negative results for transport and the economics of a railway enterprise were minimalised. The choice and the quality of transport services must not be limited too much and the enormous growth of expenses spent on the managing of substitutional transport and other working arrangements should be avoided.